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INDIA

ONE of the great agricultural regions of the world, India, like China and Russia, intrigues the interest of all who are concerned with the problems of food supply for the world. Her fertile, productive lands constitute one of the world's granaries, but her teeming populations leave little surplus, if any, after their needs have been supplied. The pressure of population upon her resources has kept India a nation of secondary political and economic strength, however great her importance.

The essential facts of her economy must be understood for an intelligent appreciation of her problems. The character and number of her population play an exceedingly significant part in her development, but nevertheless they are subordinate to the limitations imposed upon her progress by the quality and extent of her productive land. Any interpretation of India's history, and her present problems, must be based primarily upon adequate knowledge of her climate, her soils, and their relation to her agriculture. The relation of her peoples to their supply of food and minerals can not be studied without knowledge of the physical background.

The economic geographer can, and will, contribute the most decisive facts to the solution of India's problems. Whatever the importance of the racial, social, or political factors, they remain secondary to the economic significance of the land and the crops produced upon it. To this end the vast quantity of information available, but not adequately studied and evaluated, must be carefully winnowed to separate the grain from the chaff, and then this grist of knowledge must be ground thoroughly before it can be used satisfactorily.

ECONOMIC GEOGRAPHY

VOL. 9 JANUARY, 1933 No. 1

AGRICULTURAL REGIONS OF ASIA

PART III—FARTHER INDIA

Samuel Van Valkenburg

FARTHER INDIA, as southeastern Asia is called, is an excellent geographical unit. A number of distinct mountain axes extend southward and southeastward from the Brahmaputra Mountain knot, enclosing longitudinal depressions, once estuarine extensions of the sea, now alluvial plains and deltas formed by the detritus borne down from the mountain masses by the great rivers which issue from them.

Though the ranges present diverse structural differences—young, folded mountains continuous in the west (Arakan Yoma); *en echelon* in the south (Tenasserim Ranges); and uplifted block mountains in the east and northeast (Shan-Laos-Annam block); —their common direction toward the south southeast, and the common character of their intermontane basins as illustrated by the Irrawaddy, the Menam, and the Mekong, present such a regional unity, particularly as it is reflected in their land utilization, that they must be regarded as one distinct geographical entity. Local variations and complications such as the break in the range between the Menam and the Mekong Basins and the Chinese character of the Tonkin Delta scarcely interrupt the uniformity in the physiographic unity of the land which is continued into its climatological aspects.

The entire region is dominated by the Asiatic monsoons with their concomitant typical summer range which prevail throughout the region except where the deflected winter monsoon brings the rains, as on the east coast of the Malay Peninsula and Annam. Heavy rain on the windward faces of the mountains, less rain in the rain-shadowed basins, and rapid decrease of precipitation from the deltas open to the rain-bearing winds toward the interior, characterize the region throughout.

Vegetation corresponds to the amount of rainfall: dense equatorial, or in the north subtropical, forests thrive where the rainfall exceeds 80 inches; monsoon forests where the rainfall is less and where grows the valuable teak as an outstanding natural resource; and a scrub vegetation of acacia and bamboo where the rainfall is below 40 inches or the soil is unduly pervious.

As a climax to this unity of physical background, man's occupancy and activity presents the same sequence of gradations and the same unity of essential characteristics, with the highest development of culture in the valleys, where rice is the conspicuous crop throughout the area, in which sufficient water is available to the most primitive type on the mountains, where the milpa stage of

production pertains and where in some localities the culture is so primitive that it is still in the hunting and collecting stage rather than in the most primeval form of land use. In contrast with the neighboring lands, India, Java, and China, the density of population, even on the productive river deltas, remains relatively low, so that the population does not press upon the productivity of the land, and a surplus of rice is available for export from Rangoon, Bangkok, and Saigon-Cholon, the three great rice ports of Farther India.

GEOGRAPHICAL DIVISIONS

The natural divisions which correspond to the criteria discussed in the general treatment are as follows:

1. The Western Mountains (Arakan Yoma) with the Arakan coastal zone.

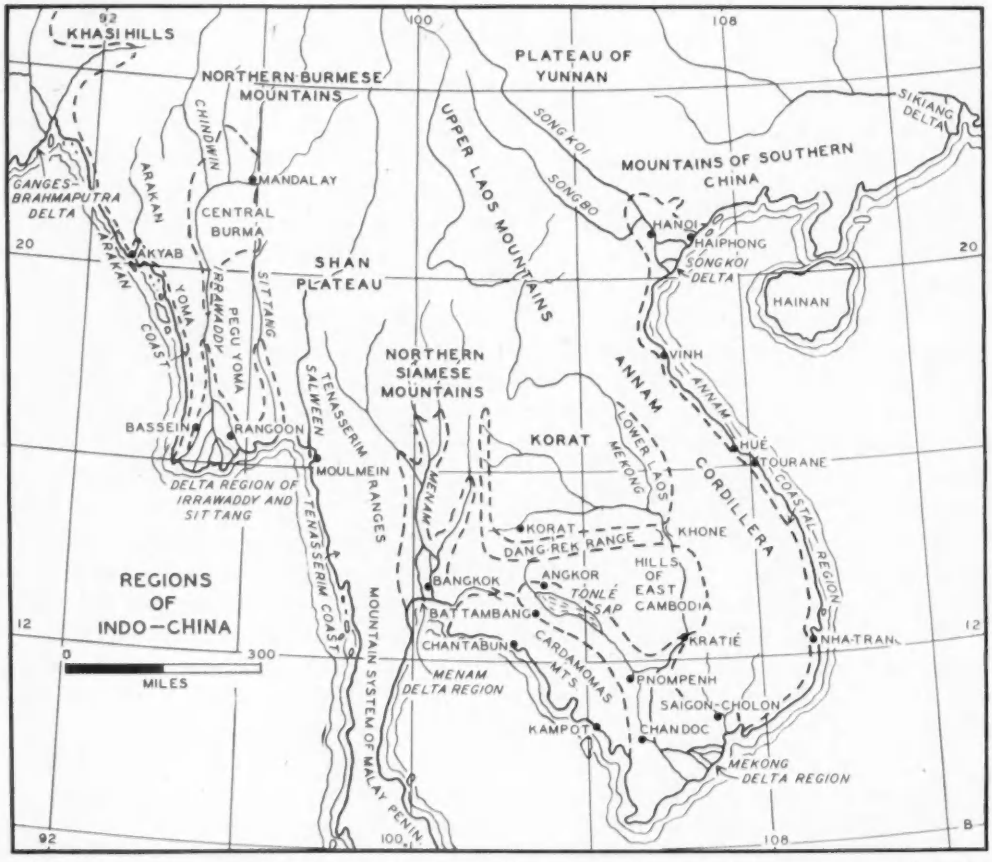

FIGURE 1.—The natural regions of Farther India or Indo-China, as it is sometimes called, are merely distinctive divisions of an integrated geographical unit, which, though differing in its details locally, and in the combination of its physical factors, presents such general similarity in the physical background and in the adjustment of human activities to it, that it forms one of those definite regions which become established as distinct unities of the earth surface.

2. The Burma Basin:
   a. The Irrawaddy-Sittang Delta.
   b. The Pegu Yoma.
   c. Central Burma.
   d. Northern Burma.
3. The Shan Plateau and its southern continuation, the Tenasserim Ranges. (The southern part of the Malay Peninsula, being more equatorial, will be treated with the Malay Archipelago.)

4. The Siam Basin:
   a. The Menam Delta.
   b. Northern Siam.
5. The Inter Menam-Mekong Mountain.
6. The Mekong Region:
   a. The Delta and the Tonle Sap area.
   b. The Korat Plateau and Lower Laos.
7. The Eastern Mountains (Laos-Tonkin-Annam Cordillera) with the Annam Coastal Zone.
8. The Tonkin Plain.

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For Indo-China—Jules Sion's "*L'Asie des Moussons*," Vol. 2, from the press of Armand Colin, Paris, 1928, is exceptionally good, but the following can also be recommended:

E. Bruson-P. Carton:
Le Climat de l'Indo Chine et les typhons de la mer de Chine (with atlas), Hanoi, 1930.
Risiculture en Indo Chine, Hanoi, 1931.
Roland Meyer: *Le Laos*, Hanoi, 1930.
Rene Morison:
Monegraphie du Cambodge, Hanoi, 1931.
L'Annam, Hanoi, 1931.
La Chochinchine, Saigon, 1931.

all of which were issued consequent upon the International Geographical Congress held in Paris, September, 1931.

WESTERN MOUNTAIN BORDER (ARAKAN YOMA)

A narrow rugged coastal zone fringed by numerous islands along the coast borders the complex mountain system, which extends southward as the major axis of this section, and which rises to an elevation of 10,000 feet. Both coastal zones and the bordering western slope of the mountains have heavy monsoon rainfall watering a dense equatorial forest replaced by bamboo jungle in some of the lower sections. The limited alluvial coastal plains are devoted to rice paddies. Akyab, where two north-south valleys debouch upon the coastal plain, is the most important trading center of this area, even exporting some rice. The eastern slopes of these mountains are much drier. In their forests grows teak (*Tectona grandis*), the typical and most valuable type of vegetation along the lower reaches while higher up on the slopes, oak and pine form the forests. Throughout this luxuriant mountain forest, man is still very primitive and his culture very retarded. Tribes of Chins and Karens dwell in small villages and employ for their food production the milpa type of cropping, which consists of growing corn, millet, or mountain rice in the burned clearings as long as the soil permits, and then abandoning the fields to burn other clearings where the soil is not depleted of its fertility, as soon as the original clearings become infertile through continued cultivation.

THE BURMA BASIN

The Burma Basin includes four minor subdivisions, which, however, are sufficiently similar to constitute one unified region.

The Irrawaddy-Sittang Delta

The alluvial lowland of the Irrawaddy-Sittang Delta is traversed by the network of branches and tributary streams of the Irrawaddy and Sittang River systems diked carefully to protect the surrounding land against flood, but furnishing the

water which enables the delta to give to Burma its international reputation as the foremost rice-exporting region of the world. Rice fields dominate the landscape except where the walls of tidal forest break their level uniformity and mark the transition between water and land, and low mud levees which control the supply of water to the paddies intersect the flats in every direction. The rainfall is copious, generally over 80 inches, decreasing toward the peak of the delta, so that irrigation is an inconsequent factor in the rice economy.

district of Central Burma. Compared with the rice-producing plains of India, the density of population in the rice-producing sections of Burma is remarkable; apparently the Burmese farmer does not yield himself to such concentration of population on the rice lands as does the Bengal farmer of the Ganges Delta, and prefers to let the drier sections of central Burma hold first place with regard to density of population where the political center of his land has always maintained itself.

The relatively low population den-

FIGURE 2.—The most distinctive feature in the landscape of Farther India, as it is in the human activity of the region, is the cultivation of rice on the level, or relatively level, plains and deltas, in which the constituent elements of the whole rice economy—the level fertile lands with adequate water supply, the natives, the bullocks that they use in tilling the crop, and the crop itself whether it be the green of its growing season or the gold of its harvest season—are presented. (Courtesy of Ginn and Company.)

The beginning of the monsoon range starts the Burmese farmer and his faithful water buffalo upon the annual régime of rice cultivation from the planting in May to the harvest, which begins in November when the dry season comes on. Practically all the 12 million acres devoted to rice in this section are concentrated in this one region, excepting only the small rice-producing plains on the Arakan-Tenasserim Coast and the limited irrigated rice

sity of the Irrawaddy-Sittang Delta necessitates the importation of labor from India, just as it permits every year the production of a surplus of great quantities of rice, the cereal food of the Orient. Of the average production of 7 million tons of rice a year, 2½ or 3 million tons are exported from the ports of Rangoon and Bassein, and a lesser quantity from Moulmein, chiefly to India, but secondarily to Java and other regions of rice deficit in the Far East.

The Pegu Yoma

The Pegu Yoma embraces a rolling hilly section which lies between the Irrawaddy on the west and the Sittang on the east. It is a region of valuable teak forests, particularly through the center where the rainfall diminishes northward. From this region great rafts of teak timber are floated down the rivers to Rangoon.

Central Burma

Central Burma is formed by the rolling lowland drained by the Irrawaddy and its many tributaries, of which the Chindwin is the most important. Situated in the lee of the Arakan Yoma, where the rainfall is less than 40 inches, aridity marks the area as is indicated by the scrublike vegetation and the distinctive character of the land utilization. Beyond the limits of the irrigated section which extends over 1½ million acres of rice and other irrigated crops, the agricultural products are varied and resemble those of the Deccan Plateau of India: millet, sesamum, groundnuts, and cotton. The soils, though in the main sandy, are fertile. At present much of the potentially arable land is unutilized, for irrigation could be developed to a much greater extent than at present, and barley and wheat could be successfully cultivated if the water of the rivers, instead of being utilized solely for transportation, could be diverted out upon the bordering plains.

This is the political heart of Burma, where the population is densest, but even so, it is much sparser than on the corresponding sections of the Deccan of India, which it most closely resembles. Isolation may constitute one of the reasons for this sparsity of population, since practically the only available means of transport and connection with the exterior world are by steamer along the Irrawaddy River, or 20 hours by train through the Sittang Valley.

Northern Burma

The region of Northern Burma extends from the central belt northward up to the very border of the Tibetan Plateau, changing in character from the broad river valleys like those of the Irrawaddy and the Chindwin separated by hilly uplands in the south, to massive mountain masses in the north. Throughout the region, density of population is very low except in the limited valley lands where rice can be produced for food. The monsoon forest yields valuable timber, especially teak, but where higher elevation leads to heavier precipitation, the forest consists chiefly of pines and rhododendron. Shans and Kachins form most of the population, which is scattered and nomadic, but great expanses still remain practically unexplored and unknown.

THE SHAN PLATEAU

The Shan Plateau is so little known and so little material is available regarding it that the following description taken from L. Dudley Stamp's article on "Burma" in the *Geographical Review* for January, 1930, constitutes the only available material:

> The geographical region which has been called the Shan Plateau coincides closely in extent with the Federated Shan States and is a continuation of the Yunnan Plateau of China; and actually the Chinese do not recognize the boundary shown on British maps as separating the Chinese Shan States from the Burmese Shan States. To the southeast the plateau merges into northern Siam, the word Siam

being really the same as the word Shan. The Burmese portion of the plateau is generally between 3,000 and 4,000 feet high, terminated abruptly on the west where an almost continuous scarp edge, about 3,000 feet in height, overlooks the Sittang and Irrawaddy valleys. The plateau is divided into western and eastern portions by the deep narrow trench occupied by the Salween River. Like most of the rivers of the region the Salween is an obstacle to communication because it interrupts the rolling surface of the plateau, although there are considerable stretches of it which are navigable.

The Shan Plateau is clothed with evergreen forests interrupted over wide areas by rolling grassland and here and there by tracts of pine forest. The whole area is an interesting example of a natural region. It was so cut off from the Irrawaddy Valley and Burma that until recently the familiar bullock cart of the lowlands was unknown there. The plateau is sparsely inhabited by hill tribes, of which the Shans are the chief, but which include also Kachins, Palaungs, and Was. Special interest attaches to the last named, which are commonly divided into 'tame' Was and 'wild' Was. The wild Was living to the east of the Salween still indulge on the quiet in the time-honored practice of head-hunting, and their territory has been placed out of bounds to Europeans.

There are immense tracts of rolling country suitable for crops. Rice is grown together with potatoes, vegetables of all sorts, fruits (oranges, pineapples, strawberries, etc.), and in some places wheat. Elevation tempers the climate; the rainfall throughout may be described as moderate and possibly averages about 60 inches; and it should be possible to grow large quantities of the chief crops of temperate lands. The more hilly parts of the plateau are of less importance, although in some areas the forests are of value.

The character of the land utilization probably so closely resembles that of northern Siam, which lies adjacent to this region, that it may best be referred to the discussion of that section on a further page.

The Tenasserim Ranges

Extending out from the Shan Plateau the Tenasserim Mountains form the west side of the Menam Plain, continue southward under different names, and finally merge with the *en echelon* mountains of the Siamese Malay Peninsula. The heavy precipitation in the south, falling in different seasons on different slopes—winter monsoon rain on the east slope and summer monsoon rain on the west slope—produce a dense equatorial forest where only the very primitive negroid Somang tribe and the Sakai of Malay origin roam, collecting for food the roots and nuts and fruits and the animals that the forest affords.

On both sides, principally on the northwestern or Moulmein coast and along the east shore, fertile coastal plains of slight extent are used for the cultivation of rice; the rather advanced stage of land utilization, which characterizes the Malay population which here replaces the Siamese, contrasts sharply with the adjoining primitive collection stage of culture in the mountains. Rubber plantations, an extension of the great rubber-producing area of the Malay states, introduce another feature of land use. On the mountains west of the Menam, where the vegetation reveals the drying influence of the rain shadow, the Karens form most of the population as they do on the Burmese Mountains, and live mostly by the milpa type of agriculture.

THE SIAM BASIN

The Siam Basin includes two distinctive regions, one of which, the Menam Delta, forms the counterpart of the Irrawaddy-Sittang lowland, and the other embraces the ridges and valleys of Northern Siam.

The Menam Delta

A wide estuary has been silted up with alluvial clays by the Menam

River system, and now forms a flat delta plain, about 100 miles wide near Bangkok, narrowing northward and projecting many branches into the depressions of the surrounding hills, which with their monadnocks constitute a transition to the mountains eastward, northward, and westward. The gradual transition from hills with broad intervening lowlands to complex mountain structure is most noticeable northward.

The monsoon control of the climate is essentially simple. Early in May the southwest monsoon initiates the rainy seasons for approximately 200 days, and lower summer temperatures because of the high percentage of cloudiness. Rainfall on the Menam Plain averages 50 inches annually, with its maximum in late summer. The Tenasserim Ranges account for the diminution in precipitation as compared with the Irrawaddy Delta. In November the north monsoon assumes domination, and the sky clears and the temperature sinks to 75° F. with cool nights. As the sun rises in the sky, the temperature rises to 85° F. in February, which continues until the land warms sufficiently to produce the resumption of the summer monsoon in early May.

Rice is the major crop of the Menam Valley, so dominating the landscape that nothing breaks the monotony of the continuous mosaic of small, mud-walled, square rice fields except the scattered clumps of fruit trees planted round the houses, pile-supported, of the villages. The Tai (Siamese) generally owns his property, which averages an area of 40 to 50 Rai, a rai or rice field unit being 130 feet square. During the winter and the warm season, the plain lies idle with only a few bedraggled buffalo seeking a little food in the stubble and aftermath of the latest crop. The heavy clay soil is parched, entrenched with deep crevices.

As soon as the first May rains soften the ground, plowing begins early in June, and the landscape becomes alive with water buffalo wading deep in the soft mud as the peasants till their land. In July the young rice (*bibit* in Malay) is transplanted from the heavily fertilized soil of the nursery plots to the rice fields where it is to grow to maturity. The heavy rainfall in September is followed by the flood of the Menam River, spreading over the whole area until the plain becomes virtually a shallow continuation of the Gulf of Bangkok, with only the trees and the pile villages along the canals and river branches standing above the water. The flood waters augment the rains so that the average rainfall suffices not in itself to guarantee adequacy of moisture for the rice culture, but do keep the fields fertile and productive in spite of constant cropping without any addition of manure or fertilizers.

The height of the flood almost measures the assurance of the success of the crop. With an unusually light flood, drought threatens ruin to the rice harvest. With an unusually heavy flood, the rice crop may be drowned. Only when the flood averages about 12 feet higher than sea level, at Ayutia, which is the normal flood, is a good crop assured. The following chart prepared by Credner reveals the close relationship between flood and rice harvest; at times almost 50 per cent of the crop may be ruined by lack of water or by excess of water. The hazard of light flood or of heavy

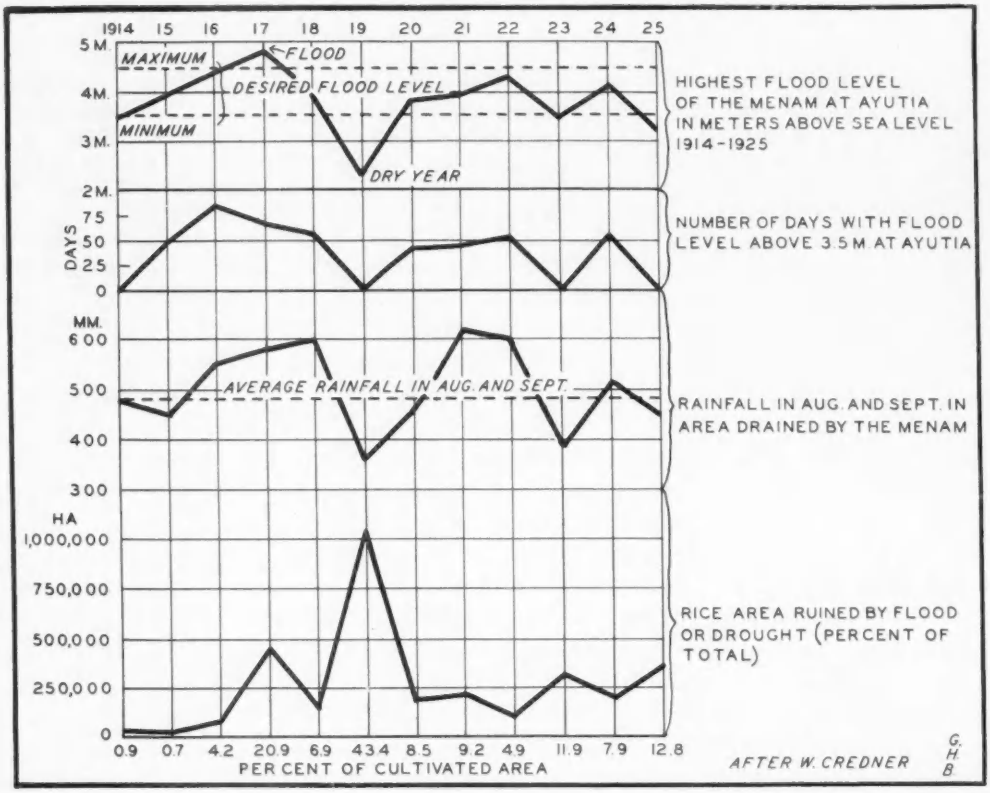


FIGURE 3.—The relationship between the floods, the duration of floods, and the rainfall, to the rice area ruined at times by flood or drought, is strikingly presented in this chart, which links the critical and essential factors in the climate with the culture of the principal crop of the region, the crop upon which the whole economy of Farther India is based.

flood has determined the density of the population, 125 to the square mile, relatively slight for an area of rice production, and explains the relatively large export of the cereal in times of favorable crop conditions. With an area of 7.2 million acres planted to rice and a production fluctuating in recent years from 7,200 down to 5,300 million pounds, the export quantity varies from 3 to 4 billion pounds in good years down to 2½ billion pounds in unfavorable years.

Well-organized irrigation would not only avoid these great fluctuations and lead to a steady, high production, but would also increase the area for crops immensely; at the present time the proportion in cultivation on the lower lands does not approach 40 per cent of the total area. The hilly uplands surrounding the basin, with their broad valleys devoted to rice, are well adapted to grazing cattle besides the present lumbering of teak. An exchange of products takes place between the cattle-producing, rice-consuming hills and the rice-producing, cattle-producing lowlands. Bangkok forms the port of rice export, where the Chinese own the rice mills and monopolize the trade.

Northern Siam

The North Siamese section begins about 18° N. The southward flow-

FIGURE 4.—In Siam, as in all the parts of Farther India, the rice harvest brings to the people an assurance of welfare and prosperity, or of difficulty and distress, dependent upon whether the rainfall and flood conditions have produced an adequate crop or an insufficient crop. If there is any season of the year in which the natives are satisfied with their land more than at any other time, it is the harvest season, when they know what the results of their season's labor have been. The background of bamboo, before which this pastoral scene is enacted, characterizes the villages in which the rice cultivators dwell. (Courtesy of Ginn and Company.)

ing rivers, of which the four upper tributaries of the Menam are the most important, flow in valleys in places wide and regular, but in other places very narrow. From the valleys, steep slopes ascend to gentler sloping uplands of an old erosion surface at an elevation of from 3,000 to 4,000 feet at the south, increasing toward the north to nearly 9,000 feet. As in the Menam Plain, the rainy season comes in summer with precipitation varying from 40 to 50 inches on the lowlands and increasing to more than 80 inches on the mountains. The northwestern portion in the lee of the Shan Plateau is appreciably drier.

The winters are cool, indicating the effect of the more northerly latitude. Diurnal changes are relatively great, since the early morning temperatures may fall below 50° F. Except in the cultivated valleys, forest mantles the whole land, being of the monsoon type, bearing an abundance of teak in the drier parts and of the equatorial, approaching temperate, type, on the higher mountains. The so-called Lao (Siamese), a slight variation from the Tai of the Menam Plain, occupy the valleys. Though the irrigated rice fields are most conspicuous, sugar cane, tobacco, and cotton constitute part of the crops on the alluvial fan and scattered mulberry trees reveal the feeding of silkworms and the production of silk. Buffalo for cultivation of the rice fields and draft cattle for transportation graze on the higher hills in summer, and feed on the aftermath of the harvest in the valley croplands during the winter. Timber is cut from the forest. The enterprise of the white man is shown in the cutting of teak and its transportation to the lowlands, an industry in which tame elephants are utilized in part for transportation.

On the forested slopes, 2,000 to 3,000 feet above the valley, an

entirely different type of land utilization is practiced. Here tribes like the Karen and the Lawa of different racial origin live a real forest life supplemented by milpa agriculture. They cut down the branches and scrub during the winter months, and burn everything in the fall, when the glow of forest fires on the mountain slopes may be seen for hundreds of miles. In the burned clearings, usually from two to three Rai in extent, rice is planted with the hoe, and harvested with a sickle at the close of the rainy season. New fields must be opened every year. The barter between these mountain dwellers and the residents of the valley is composed chiefly of the exchange of a few forest products for salt.

On the higher uplands a third type of economy dominates the use of the land. The Meo (or Miau) and the Yao, relatively recent invaders from the north, cultivate mountain rice (less glutinous than the rice of the valleys and lower slopes) and raise stock, chiefly swine and horses.

This exceedingly interesting vertical zonation of types of land utiliza-

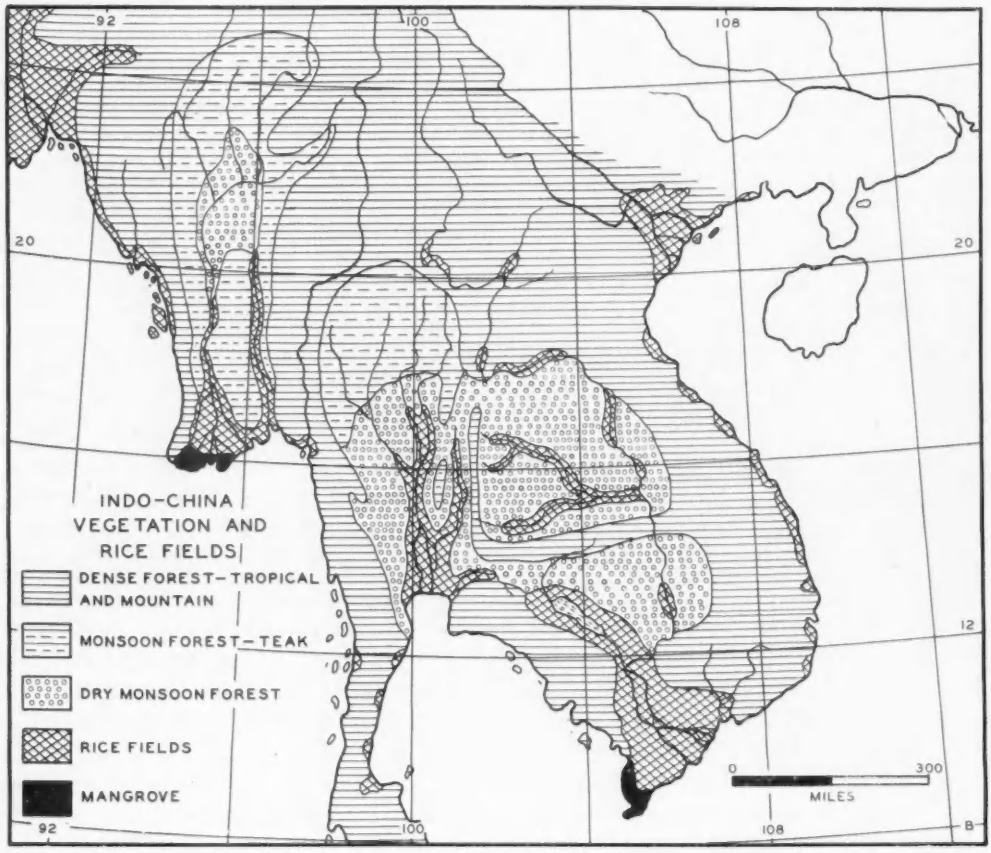


FIGURE 5.—The distribution of vegetation, particularly the teak and the rice, for both of which Farther India is so well known, is primarily related to the climate, and secondarily to the relief and the soils. Not only does the distribution of vegetation reflect the physical environment, but it also indicates the distribution of the density of population, because wherever the forests dominate, the population is relatively sparse, and where the rice fields dominate the landscape, population is relatively dense.

tion by different racial groups with different environmental backgrounds is typical of southeastern Asia, where it is found not only in Siam but also in northern Burma, and in Laos-Tonkin. In this latter section four definite zones of distinct types of land utilization and racial composition can be distinguished in places.

FIGURE 6.—The Burmese, like the Siamese, thresh their grain by the ox-hoof method. The boy rides the one carabao and leads another by the nose, thus achieving twice the efficiency that he would if he had but one animal. As the grain is beaten out, the straw is raked to the side, leaving the chaff and the grain to be winnowed later. The level plain upon which the rice is cultivated stands out in striking contrast to the higher lands beyond, where the forest controls the economy. (Courtesy of Ginn and Company.)

THE INTER MENAM-MEKONG MOUNTAIN

The mountain ranges between the deltas of the Menam and the Mekong, combined under the name used in the French publications, the Cardamom Mountains, are very little known.

The Cardamom Mountains

The Cardamom Mountains, which extend from Siam into Cambodia, do not attain high elevation, the highest point being under 5,500 feet altitude. Extending from northwest to southeast, they oppose the southwestern monsoon and cause a heavy precipitation exceeding 160 inches, except in the low central saddle where it is considerably less. The heavy precipitation promotes a dense equatorial forest, which covers the entire mountain group.

Density of population is extremely low throughout the region, except on the scattered coastal plains like Chantabun in Siam and about Kampot in Cambodia, where irrigated rice fields produce adequate food; only a few tribes like the Indonesian Moi and the Negritos roam through the forest, depending upon its wild life and a sparse hoe agriculture for

their sustenance. In the neighborhood of Kampot, the cultivation of pepper assumes more than local importance, and an export surplus becomes available.

The mountains about the Korat Plateau, which really belong to this division, are treated with the plateau as a part of the Mekong System in the next section.

THE MEKONG REGION

When the Mekong has crossed the Dang-rek escarpment at the Khone Rapids, it continues its course through the sandstone plateau, which fronts upon the Dang-rek southward to emerge finally at Kratie upon the great delta plain, which the river built up into the estuary or gulf which once extended far inland northwestward. In the same way as the Colorado River separated the Imperial Valley from the Gulf of California by building up its delta, so the Mekong River built up its intersecting alluvial delta across this northwestern estuary and formed the Tonle Sap depression, which lies below the flood level of the Mekong. In late summer it is submerged and forms a vast lake; in the dry season the flood waters drain off toward the Mekong and the Tonle Sap is left as a shallow stagnant pool.

At Pnompenh the real delta begins, and there the Mekong divides into a number of distributaries connected by anastomosing creeks to form the complicated delta structure of most of Cochin China. Marshy plains like those in the southwestern sections (*Plaine des Oiseaux*) and in the region west of Saigon (*Plaine de Joncs*) alternate with the more elevated land of the many interdelta sections. Rivers from the thickly forested Annam Plateau debouch upon the delta. Saigon-Cholon owes its preëminence as a great rice-exporting port to its location on one of these rivers which has become an actual arm of the sea, meandering through the flat lowland plain unaffected by the silt of the heavily laden Mekong. Rice is the important crop, as it is on the Irrawaddy and Menam deltas. The following types of rice cultivation can be distinguished:

1. The rice culture dependent upon the monsoon rains, which aggregate 60 inches for the greater part of the delta and fall entirely in summer. It is found on the higher ground in the north, on the older alluvial deposits of the delta, and around the summer extension of the Tonle Sap. The rice fields are prepared after the rain has begun, and harvest begins when the dry season has reëstablished itself.
2. The rice culture found in those sections which are only slightly flooded, where the soil is often of a peaty character, and the rice transplanted twice and not transferred to the final field before the plants have attained a height of more than two feet. The grain is harvested at the height of the dry season.

   This type yields most satisfactorily—2,600 kilograms per hectare as against 1,000 kilograms per hectare for the previous type. This type is most highly developed on the two sides of the Bassac branch of the Mekong in the neighborhood of Cantho.
3. The rice culture of the so-called floating rice, in those areas which are arid during the winter monsoon and flooded during the wet season. The Chandoc section south of Pnompenh exhibits this type in its best form as also do the flooded borders of the Tonle Sap. The young rice plants are set into the ground before the flooding, keep growing steadily during the flood period, and can maintain themselves above the surface if the flood is normal. When the flood subsides, the stems fall prostrate on the ground, develop new roots, reraise themselves, and the grain ripens a month later. The yield under this type is about 2,000 kilograms per hectare.

FIGURE 7.—The Siamese natives, whatever their ancestral background, depend essentially upon rice as the chief constituent of their dietary, and whether they live in clearings on the forested upland or on the broad plains of the coast and the deltas, the rice harvest constitutes the most important part of the year. (Courtesy of H. G. Moore.)

4. The rice culture of the post-flood period, which may be called dry-season rice and which depends entirely upon the moisture retained in the soil after the floods have subsided.

The upper part of the delta and the Tonle Sap, both of which are in Cambodia, produce only a small surplus of rice in normal years, but the lower delta in Cochin China regularly produces more than twice the amount needed for local consumption. The average production for the last five years of 285 million kilograms provides an export surplus of 156 million kilograms. As in Siam, the surplus depends primarily on the character of the floods, with exports shrinking 50 per cent in bad crop years, which alternate with the better years of full average surplus. A comparison between Cochin China and Siam shows that the same factors operate in the two lands simultaneously; for instance, the year 1919 resulted in a heavy deficiency in both Siam and Cochin China as a result of conditions which prevailed throughout both countries.

The uncertainty of production probably accounts for the low density of population, but unfavorable political conditions constitute an additional explanation, for this region is a zone of contact between the Cambodians, descendants of the Mon Khmer civilization, that built the great Angkor structures of which the ruins still stand on an outlier of the sandstone plateau north of the Tonle Sap, and the Annamites who later invaded the region and both by war and peaceful penetration have pushed the Cambodians continually westward. The Cambodian civilization represents a high cultural development.

Rice culture monopolizes the use of the land, so that only a few other crops, like corn, tobacco, and cotton, receive secondary attention. Coconut trees, which surround every rural village, contribute somewhat to the economy of the people and the character of the landscape.

Stock raising becomes relatively important on the dry sandstone uplands, such as south of the Dangrek, where the character of the vegetation indicates excessive drainage and pervious soils. European companies have recently established

rubber plantations, which seem assured of success, on the red basaltic soils of the outliers of the southern Annam Plateau, north of Saigon. These plantations now comprise an area of 250,000 acres and send their product to the Michelin factories in Clermont Ferrand, France.

During the floods fishing assumes temporary and local importance in the Tonle Sap; nets of tremendous size are used.

The Korat Plateau

A steep escarpment forms the western and southern encircling boundary of a sandstone plateau approximately averaging 500 feet elevation, which continues eastward to the Annam Mountains. The escarpment, known under different names, such as the Dang-rek and others, rises from 3,000 to 4,000 feet high. The Mekong crosses the plateau and descends the escarpment by turbulent rapids along the eastern margin, and separates Lower Laos from the Korat Plateau. On the densely forested escarpment, the rainfall rises to 80 inches, but on the plateau itself it diminishes to 50 inches. The aridity for which the region has become known through the xerophytic character of its scrub vegetation, consisting of acacias and other thorny bushes and bamboo, is determined by the extreme drainage of the pervious sandstone soil rather than deficient precipitation.

Rice fields are found only on the broad, fertile, alluvial river plains, but persistent floods held back by the high level of the Mekong River throughout the flood period restricts the area that can be devoted to rice. The cultivation of cotton and tobacco and pepper, and the growing of mulberry trees for sericulture, is found in the neighborhood of the villages; but the red soils of the higher divides between the valleys are old and depleted of their fertility and can be used only for extensive grazing.

More than half the Siamese stock is found on the Korat Plateau: cattle, buffalo, and swine. A lively exchange is carried on between the stock-exporting plateau, and the rice-exporting Menam plain.

Although the drainage system is toward the Mekong, the economic outlet is westward by way of steep trails over the escarpments, or the railroad from Bangkok almost up to the Mekong.

The Korat Plateau is economically poor, and sparsely populated, compared with the delta plain. Conditions in French Lower Laos are similar to those on the Korat Plateau.

THE EASTERN MOUNTAINS

The Eastern Mountains form a great block of complicated structure, deeply eroded with locally broad river valleys bordered by abrupt slopes.

The Laos-Tonkin-Annam Cordillera

The Laos-Tonkin-Annam Cordillera is a broad, practically inaccessible, mountain mass in the north which narrows southward and affords rather easy passage for the modern motor roads which have been built to facilitate connection between the Annam Coast and the rice-producing valley of the middle Mekong, which constitutes the chief economic area of Laos.

Dense forest covers the mountains, consequent upon the heavy rainfall. On the lower slopes the vegetation is tropical; on the higher slopes it is of the temperate type in the south, and cool temperate in the north, where

pine forest and alpine meadows are found on the highest ridges and crests. The land use is dominantly nomadic as in the mountains of Burma and Siam, except in the valleys where the Annamites have entered from the east, and the Tai live in the west where they did not emigrate to Siam after the French occupation. As in the Cardamom Mountains and the Dang-rek, the Moi still constitute the chief element in the population. Though they still use chiefly the milpa type of agriculture, they exhibit a beginning tendency toward sedentary life with permanent villages and the rearing of cattle and swine. In times of deficiency of crop, however, they revert to the primitive system of collecting food from the forest and to hunting.

Northward conditions are much more complicated, resembling those of neighboring northern Siam. Sion relates an example from northern Tonkin, where the Annamites live on the lowland plains; the Nung and the Tho, both related to the Tai, in the upper valleys up to 1,200 feet; Mongoloid peoples in the tropical forest belt between 1,200 and 2,500 feet; and the Mongolian Meo or Miao, who are the last immigrants, above the 2,500-foot altitude. The penetration of white man civilization

FIGURE 8.—Teak represents in the utilization of the drier monsoon forest of Farther India the same importance relatively, as does rice in the crop utilization of the land. The log rafts on the Menam River are just as distinctive an element in the water landscape as the rice fields are in the crop landscape itself, and represent a comparative degree of wealth and commercial importance. The lumber industry of Farther India has played an important part in the penetration of the white man's civilization. The teak forests represent the white man's frontier in Farther India. (Courtesy of Ginn and Company.)

and activity is still in the frontier stage except on the red soils near Saigon, already mentioned, where rubber plantations have been established. The teak forest of Laos, isolated and practically inaccessible, remains untouched by any lumbering operations.

The Annam Coast

The narrow coastal zone which borders the Annam Cordillera is interrupted in many places by mountain spurs which project to the sea. The coastal plains are formed from the alluvial deposits of the relatively short coastal streams which build up long bars studded with dunes which enclose inland lagoons. It is a region of special significance because of the distinctive seasonal distribution of rainfall with a decided autumn maximum. The copious rainfall, between 100 and 160 inches, and high winter temperatures which rarely fall below 70° F., combine to make the limited plains exceedingly productive.

Two types of cultivation are distinguishable, one for the drier season and one for the moister. The wet season is the real rice time, when it is grown everywhere that flooding permits. Three different types of production of rice may be enumerated: the rice of the eighth month, the tenth month, and the twelfth month as designated by the Annamite calendar, which corresponds rather closely to ours, except that February is their first of the year. Work continues from April–May for the eighth-month rice and from June–August for the tenth- and twelfth-month rice. The harvest extends from October for the eighth-month rice, to November for the tenth-month rice, and even to January for the twelfth-month rice.

The second type of cultivation, that of the drier season, shows a great variation in the crops with sugar cane, corn, and rice utilizing most of the land, though rice of the second crop is relatively rare. This dry-time rice culture may be divided into two types: the third-month type and the fifth-month type. Both are planted during the fall rains and the third-month type is harvested in April, and the fifth-month type is harvested in June. During the period of this second type of cultivation, irrigation assumes considerable importance and reveals the relic influence of the ancient Cham cultivation which succumbed in the fifteenth century before the aggressive culture of the advancing Annamites, who had been pushed out of southern China by the Chinese. In this period, ingenious water-wheels of exceedingly ancient type are still used, but in recent years the French Government has endeavored by modern methods to extend the irrigated area. Vinh, Hue, Quanj-ngai and Quinhon form centers of local, cultivated, coastal plains, which grow 627,000 tons of rice, ample for local needs, but barely sufficing for significant export.

THE TONKIN PLAIN

The Tonkin Plain has been formed by the alluvium deposited by the many mountain rivers which debouch upon the sea, and of which the red, or Songkoi, and the black, or Songbo, unite to form the most important delta. The plain is surrounded by mountains of considerable elevation. It differs from the other deltas of southeastern Asia, not only because of its smaller size, but because the rivers which traverse it and have formed it have so little space in

FIGURE 9.—The interesting part that water plays in the activities of the lives of the people of Farther India in the production of their chief crop, the transportation of many of their products, and the travel that is necessary to the contact between the several parts of the region, is reflected in this busy scene on the Bang Klong, a tidewater canal, filled with sampans engaged in all kinds of enterprise, while the tide is in, but stranded on the bed of the canal when the tide goes out. The cities of Holland and Scandinavia are hardly more dependent upon their water courses than are the cities of Farther India. (Courtesy of Ginn and Company.)

which to assume the character of base-level streams that they retain much of their turbulent mountain character as they cross the flat lowlands and build up high, natural levees which separate them from the swampy, interfluvial basins. Protection against flood from these high-trenched rivers has everywhere been necessary, and Chinese experience and influence have led to the construction of great additional dikes, which must be continually tightened and strengthened as the rivers build their beds higher and higher. The French engineers must work toward the solution of the same problem that has faced the natives and the Chinese, and they have added dredging of the channels to the technique of building the dikes and have further protected the basin by reforestation on the water-sheds roundabout to hold back the seepage and ground water. Even so, the flood waters of the Red, or Songkoi, River sometimes rise 30 feet above the low-water average.

The climate is regimented by the typical monsoon, characterized by warm, rainy summers when most of the 60 to 70 inches of the rain falls in June, July, and August and a rather cool winter season, when the temperature for January averages 62° F. In January the dry season is replaced by the crachin period with overcast skies and slight showers, consequent upon cyclonic depressions over the Tonkin Bay.

Irrigation plays an important part in the rice economy of this section as well as does the diking against floods. Irrigation is necessitated by

the rather inadequate rainfall, particularly when the precipitation is below normal. Natural flooding is not practical, as the water would stagnate between the levees and keep the basins submerged. Near the outlet irrigation is provided by canals open to the movement of fresh water at low tide, but closed to the insweep of salt water at high tide. Higher on the delta, where the gradient of the slope is considerable, dams may be constructed and water poured over the fields by gravity. In the middle section, irrigation is most difficult, and large pumps must be installed to keep the water supply properly adjusted by taking out the water in times of excess, and pouring it in in times of deficiency. Land utilization is more varied and the kinds of crops more numerous than on the other delta plains of southeastern Asia. The bamboo-bordered villages are surrounded by fields of corn, sugar cane, sweet potatoes, and vegetables, with here and there a sprinkling of cotton fields and mulberry trees. The rice culture, however, dominates.

Three types of rice culture may be distinguished: fifth-month rice, tenth-month rice, and two-crop rice. The tenth-month rice is the regular summer monsoon type, planted in July and harvested in November. The fifth-month rice is planted after the subsidence of the flood in the low basins, which are flooded during the rain season, and is harvested in June. The two-crop rice is grown on the land not high enough for the typical tenth-month type nor low enough for the fifth-month type; the farmer tries to combine both methods for either is insufficient, but both combined produce adequate crops. Average yields are as follows:

	Kilograms per Hectare
Fifth-month Rice—Not Irrigated	1,200
Tenth-month Rice—Not Irrigated	1,600
Two-crop rice	2,600
Fifth-month Rice—Irrigated	1,700
Tenth-month Rice—Irrigated	2,300

The total average annual production for the last half decade—2 million tons—has supplied a surplus of one-fourth million tons, which has been exported from the port Haiphong.

The density of population over the whole lowland zone, extending on to northern Annam is more than 375 to the square mile, the highest density over a considerable area to be found in all Farther India.

THE COAST PLAINS OF SOUTH INDIA

PART I

Ethel Simkins

THE area treated in this study comprises the plains of South India on the west coast from the Narbada Valley in the north to Cape Cormorin in the south, and on the east coast from the Northern Circars of Madras to Cape Cormorin. The bulk of the area is in the Bombay Presidency on the northwest and the Madras Presidency in the east and southwest. The rest is in the native states of the south, Travancore and Cochin, and various smaller ones scattered through the Bombay Presidency.

The plains so delineated form a narrow fertile fringe between the sea and the edge of the Deccan plateau, and they are some of the richest areas in Southern India, having an advantage over the Deccan in their climate and, in some parts, in soil conditions also. They are nowhere wide, being as narrow as twenty miles in places on the west coast.

The western plains, though low lying, are crossed by spurs of the Ghats which take away from their flat nature and also from their fertility. These Ghats rise sheer from them to a height of 2,000 feet in the north and 3,000 to 4,000 feet in the south, and present the appearance of a gigantic wall or sea cliff. This narrow coast plain is one of marine denudation, and it extends to the foot of the Ghats, down the steep slopes of which flow short and swift streams. Thus the western plain lacks that fertility which the eastern one derives from its great rivers. Only two rivers on the west bring down a load of silt, the Narbada and the Tapti, and these build up the richest coastal areas of the Bombay Presidency in Broach and Surat.

The eastern rivers are the chief

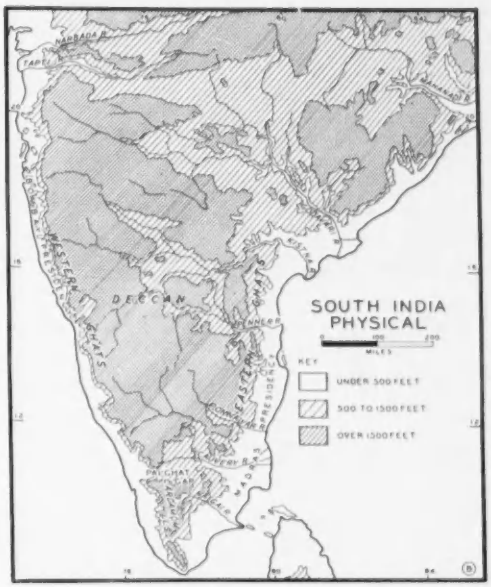


FIGURE 1.—The distribution of elevations in India, south, must be utilised in any interpretation of the climate, soils, vegetation, or distribution and character of population.

features of that plain. The watershed of South India lies on the crest of the Western Ghats, and the rivers which debouch on the eastern plain have traversed the width of the peninsula. In their course across the plain they deposit silt to build the vast deltaic systems which constitute so much of the wealth of the Madras Presidency. The chief of these deltas are formed by the Godaveri, Kistna, and Cauvery Rivers.

South of the Palghat gap much of the country is plain land in which are the remnants of the plateau which tapers away in the Anamalai, Palni, and Cardamom hills to Cape Cormorin, leaving wide plains on the east side (Madras) and on the west side (Travancore). On the east, outliers of the plateau are found in the Shevaroy and Pachmalai hills, these being formed of old metamorphic schists and gneisses like the plateau.

The plains are essentially agricultural in nature, and the significance of the physical features as the ruling factor in their agriculture is therefore great. For India as a whole the importance of agriculture cannot be overestimated, since 73 per cent of the population is dependent upon it. Particularly is it important in the region of these coast plains which are continually sending their surplus population to swell the labor on the Malayan, Cingalese, and Burmese rubber and tea plantations. They are already some of the most highly cultivated parts of India, and even with improvements in agriculture cannot hope to support any larger population than they do at present. This is particularly applicable to the deltaic areas where the cultivation for centuries has been at a very high level, and where irrigation is no new factor. The pressure of population here is enormous.

This study will first treat of the soil and climatic conditions which are the basis of the agriculture. Next will be considered the distribution of crops and the production regions in relation to this physical basis.

FIGURE 2.—A typical landscape in the eastern delta regions, showing land prepared for sugar cane and irrigated from a branch canal in the Godaveri delta. (Courtesy of Indian Trade Commissioner.)

SOILS OF THE COAST PLAINS

The soils of the plains are surface deposits derived from the high lands bordering them, and hence are similar in many respects to the soils of the plateau [1] being either black cotton soils (regur), red soils, or lateritic soils. The general features of their distribution are as follows:

On the west coast in the trap country of the north, that is, the basalt area in Western India, detrital black cotton soils predominate, they being richest and deepest in the valleys of the Tapti and Narbada Rivers, and giving place to poorer sandy red soils on the upland ridges. South of the rivers the soils are

[1] Simkins, E. *Agricultural Geography of the Deccan.* Page 7.

chiefly red loams and laterites, and there is little silt brought down by the short swift streams.

The richest soils of the plains are on the east in the great deltas. Here there are rich dark loams with areas of black cotton soil in parts. All are fine and mixed. Elsewhere on this plain the soils vary from red loams and laterites to poor sands and gravel on the uplands.

All along the coasts on both the east and the west are fringes of saline sandy soils and brackish backwater which extend for some distance inland, particularly in the south.

The chief aspect of soil study in relation to agriculture is the relative productivity of the different soils types, this depending on such factors as texture, chemical composition, and drainage. All these features must be considered in relation to the climate, since some soils react differently under the same climatic conditions.

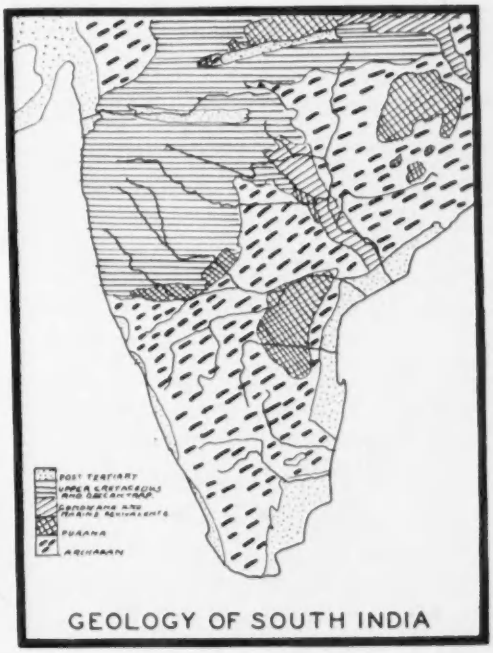


FIGURE 3.—The Deccan Trap is the great lava plateau of western India with which the black cotton soil or regur is closely associated.

On the basis of productivity the soils of the coast plains have been classified into the following types:

Type Class		*Soil*	*Example on Plains*	*Example of Similar Soil on the Plateau*
Black soils or regur	A1	Deep black, heavy.	Surat and Broach. (Plains of Narbada and Tapti.)	Tapti Valley (Khandesh).
	A2	Medium black, heavy.	North Konkan Trap areas.	East Bombay Deccan.
	A3	Poor black or sandy red.	Uplands of Trap area of Konkan.	Rugged Trap uplands of Bombay Deccan.
Red loams	B1	Deep dark brown and red-brown loams in valleys of red soils regions and deltas of Eastern rivers.	Kistna River.	Wainganga Valley. Central provinces.
	B2 (a)	Medium red loams in metamorphic and lateritic regions. Highly ferruginous and high proportion of laterite.	Southwestern plains in Malabar, etc.	
	(b)	Medium red loams overlying metamorphic rocks.	Parts of Coimbatore.	Medium red loams of Mysore plateau.
	B3	Poor sandy and stony red soils in metamorphic regions.	Uplands of Eastern Ghats.	Uplands of Mysore.
	B4	Forest loams. (Coffee soils.) Red loams or lateritic soils plus forest humus.	Shevaroy Hills.	Coffee soils in Shimoga and Coorg, etc.
Laterite	C	Dry porous soils.	Uplands of Ratnagiri.	Uplands of West Bombay Deccan in heavy rainfall regions.
Coast:	D	Varies from rich soil to salt marsh.	Coastal fringes Southern India	
Sand, salt marsh, etc.				

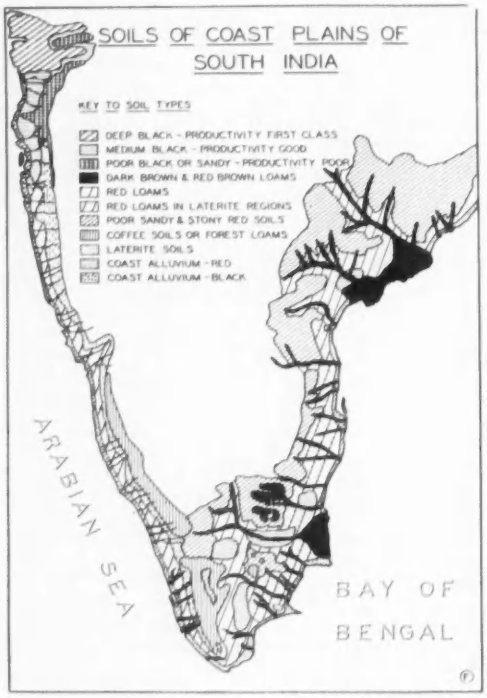

SOILS OF COAST PLAINS OF SOUTH INDIA
KEY TO SOIL TYPES
DEEP BLACK - PRODUCTIVITY FIRST CLASS
MEDIUM BLACK - PRODUCTIVITY GOOD
POOR BLACK OR SANDY - PRODUCTIVITY POOR
DARK BROWN & RED BROWN LOAMS
RED LOAMS
RED LOAMS IN LATERITE REGIONS
POOR SANDY & STONY RED SOILS
COFFEE SOILS OR FOREST LOAMS
LATERITE SOILS
COAST ALLUVIUM - RED
COAST ALLUVIUM - BLACK
ARABIAN SEA
BAY OF BENGAL

FIGURE 4.—As the distribution of the rainfall is most important, so the distribution of the soils taken in connection with the relief is secondarily important in the interpretation of the distribution of population of India.

CLASS A—BLACK COTTON SOILS OR REGUR

"Regur" on the plains is similar to that on the plateau. "It is a black or grey highly argillaceous soil with resultant high retentivity, and it is this which gives it its particular value, since it can retain water, the most precious requirement for agriculture in this region. Such is the retentive capacity of this soil, that it can conserve sufficient moisture from the 'Kharif' or summer rain crop to bring a 'rabi' or winter crop to maturity. It is further valuable in view of the erratic character of the rains during the rainy season. Long drought and sudden downpours are common, and regur being retentive, can conserve rainfall from a heavy downpour for use in a dry period. Its clayey character does not prevent it being workable after the rains save in particular cases (*e.g.* when there is a heavy subsoil as in parts of the Tapti Valley in Berar). During the hot dry season, being a clay soil, regur becomes baked hard and huge cracks are formed in the surface which extend some distance down. This cracking is one of its most valuable attributes. The surface soil, owing to exposure becomes crumbled, and is carried either by the winds or by the first rains into the cracks where it falls some distance beneath the surface. Thus there is a constant process of reversal taking place, the surface soil being carried below, and the lower layers being brought to the surface. This not only prevents exhaustion of the surface soil, but permits of thorough aeration. To these facts, together with its great retentivity, must be attributed the fertility of regur."—Extract from "Deccan Study."

Regur is deficient in nitrogen, its contents varying from .012–.05.

Its retentivity is not so vital a fact on the plains as on the drier Deccan, but it is significant in that regur lands can often be used in the dry season without being irrigated like the red soils.

A1—Deep Black Heavy Soil

The deep black cotton soil which extends along the valleys of the Tapti and Narbada Rivers forms the fertile plains of Surat and Broach. These soils, because of their retentivity, are good "rabi" as well as "kharif" lands. "Kharif" refers to the rainy season crop and "Rabi" to the cool season crop.

A2—Medium Black Soil

This is of good productivity, but neither so rich nor so deep as Class 1.

It is found on the more level or gently sloping surfaces of the trap country of the North Konkan, and in the following parts of Madras:

1. Southwest Coimbatore in the districts of Vidamalpet, Pattadam, and Coimbatore.
2. Salem and Trichinopoly along the valley of the Cauvery River.
3. In Madura and Ramnad in the districts of Tirumangalem and Ramnad and extending south to Tinnevelly, where there is an extensive deposit in the north and central parts. It forms here a belt forty miles by sixty miles and is one of the richest cotton-growing areas of Madras.
4. Smaller deposits are found in the south of South Arcot (Chiddambaram and Vriddhachallam); in Nellore at Ongole, and in a belt across the central area of Guntur, Kistna, and Godaveri (Guntur, Nandigama, and Rajahmundry).

A3—Poor Black or Sandy Red Soil

This is found on the rugged uplands of the trap country of Konkan and also in patches throughout the regur country of Madras, where some ridge or hillock juts above the level surface of the ground and does not permit of the soil attaining maturity.

This distribution fully bears out conclusions arrived at from a study of the origin of regur and its distribution on the plateau, which can be found in the Deccan study (Page 8 and seq.).

CLASS B—RED SOILS

These exhibit characters very different from regur, being sandy and not clayey soils, and thus lacking the retentive powers of regur. They are mainly kharif cropped lands, or, when cultivated out of the rainy season, are irrigated. They are found on the Deccan overlying regions of metamorphic rock in the south and east in those parts not covered by the trap, and this is true also of the plains, since the soil is brought down to them from the plateau.

B1—Deep Dark-Brown and Red Loams

These soils are the deep brown and red loams of the valleys, and they are mature soils of great productivity. With them are included the great deltaic deposits of the eastern rivers. Many types of soil are found in these deltaic areas, ranging from coarse sands and gravels to the finest silts, but much of the deltaic material is fine red or brown loam such as is found in the valleys of the rivers in red soil country of the plateau.

B2a—Medium Red Soils

It is somewhat difficult in many parts of the plains to make a distinction between the lateritic soils and the highly ferruginous red soils. So much laterite is either formed in situ on the plain, or else is brought down from the higher levels and reconsolidated as the low level laterite, that in almost all parts belts of pure laterite or of mixed lateritic and red soils are found. Such being the case, the bulk of *Class 2a* red soils of medium fertility which are found in the more level parts between the river valleys have been classified as "highly ferruginous with a high proportion of laterite."

CLASS C—LATERITE SOILS

The pure laterite soils, which have their widest and most consistent distribution down the western slopes of the Western Ghats, where the rainfall is very heavy, are of little agricultural use. They are dry, hungry, and porous soils and those districts which are most wholly formed of laterite, as Ratnagiri in Bombay, are most unproductive save when carefully manured and irrigated. The

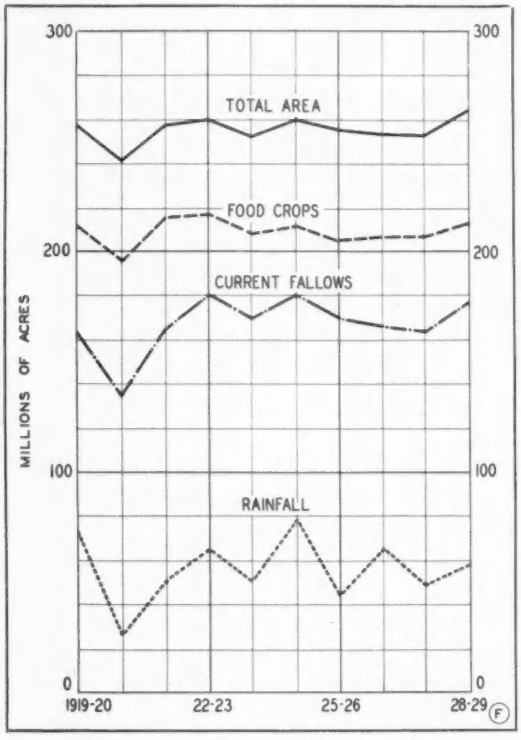


FIGURE 5.—Total area sown, area under food crops, current fallows (reversed), and variations in rainfall as compared with normal. These graphs show the close relationship between the rainfall and agriculture in India. The graphs are for the whole country and not for the Coast Plains alone. (From "Agricultural Statistics of British India," 1928–1929.)

only areas of the plains where the lateritic admixture in the red soils is not great is the southern Madras Presidency where the rainfall being much less than in any other part of the plains, laterite is not able to be formed.

Laterite is not present in large quantities in the delta areas of the Kistna and Godaveri, for the rainfall is not so high as to the north and south, and also any lateritic soils brought down by the rivers are so intermixed with the deltaic material they are not distinguishable.

B2b—Medium Red Soils

The ferruginous red soils (2b) are much more productive than the laterite and hence have been classed as of moderate productivity. They form the bulk of the soils on the coast plains of both Bombay and Madras, but in Bombay it may be noticed that owing to the heavy rainfall the amount of laterite in the soils is much higher than on the Madras side. This is another factor which decreases the fertility of the western plain as compared with the eastern.

B4—Forest Loams

The forest loams which are found down the Western Ghat slopes in Mysore, Coorg, Travancore, and the hill groups of Madras are red and lateritic loams greatly enriched by forest humus. These were brought under cultivation when the land was cleared for coffee plantations, and the enriching humus of centuries has made them of first-class productivity. They are termed "coffee soils," since this is the chief and first crop grown on them, though they are also used for tea, cinchona, and some garden cultivation.

B3—Poor Sandy Red Soils

These soils of the "Red Loam" group are the least mature of all the red soils, and are the poor gravelly weathered product found overlying the rugged areas of the metamorphic country. They are similar in character to the poor Class 3 soils of the trap area, also the most immature soils of their class. They are not worth either manuring or irrigating, and are either left barren or are cropped with hardy hill millets.

CLASS D—COAST ALLUVIUM

In Class D has been placed the coast alluvium which is found round the coast within the belts of sand and salt marsh. This alluvium in some

cases is rich, being a combination of sand with the alluvium brought down by the rivers. It supports groves of coconut palms and forms rich rice land.

In many parts, and particularly on the Bombay coast and south of it, there is a fringe of brackish salt marsh. Such areas are in many cases being drained and reclaimed for rice and coconut.

The soil division discussed above has been based partly on the productive power of the soils and partly on their origin, but it is interesting to note some of the terms given by the cultivators themselves to the different soil types. In coastal areas the land is mainly classed as "sweet" or "salt," and crops are grown on both, those produced on sweet land naturally being the best. Pressure of population does not allow the salt land to be wasted.

Throughout the coast areas of Bombay Presidency the soils are classed as (1) Rice land; (2) Garden soil; and (3) Varkas land, light poor soil of the uplands. These divisions show that different types of soil are dominated by different crops. The rice land is the rich bottom land of the valleys; the garden soil is the lighter soil which is rich when manured and watered and cultivated intensely, hence its name "garden." The "Varkas" land corresponds to the Class 3 soils of poor productivity. So important is the degree of productivity of the different types of soil that this division of land has been adopted as the basis of assessment for the land tax in this part of the Bombay Presidency.

RAINFALL OF THE COAST PLAINS

"Climatically the India Peninsula is part of the great monsoon area of Asia, and exhibits the monsoonal control in a more perfect form than any other part of this area. The term monsoon technically applies to the reversal of winds which takes place throughout the area, and which divides the climatic year into two distinct periods, that of the southwest monsoon and that of the northeast monsoon.

"'Monsoon,' however, to the Indian cultivator means but one thing —rain—since 85 per cent of India's rainfall is brought by the southwest monsoon. Perhaps in no other region of the world does the climatic régime enter so much into every aspect of life as in the Indian Peninsula, this from the fact that life there is based on agriculture which is dependent for its existence on the rainfall, this in its turn almost wholly dependent on either the southwest or northeast monsoon." . . . "Nowhere was the spectacle (anticipation of the monsoon) so stupendous as in Malabar. . . . , even a week beforehand one might see, all along the coast dense crowds of people, who, evening after evening, left the towns to gaze expectantly in the direction from which it was anticipated that the first ragged fragments of the flying wrack would come." . . . "From the moments when the monsoon sends its first shower of rain upon the earth the face of the whole country is changed. Where on the previous day nothing was visible but the dry, bare, yellow soil, a fresh green overspreads it by the second day, and within a week flowers are everywhere bursting from their buds." . . . "Thus the monsoon is the pivot upon which the whole of Indian life swings, and any variation in this pivot however slight means a consequent variation throughout the whole structure of

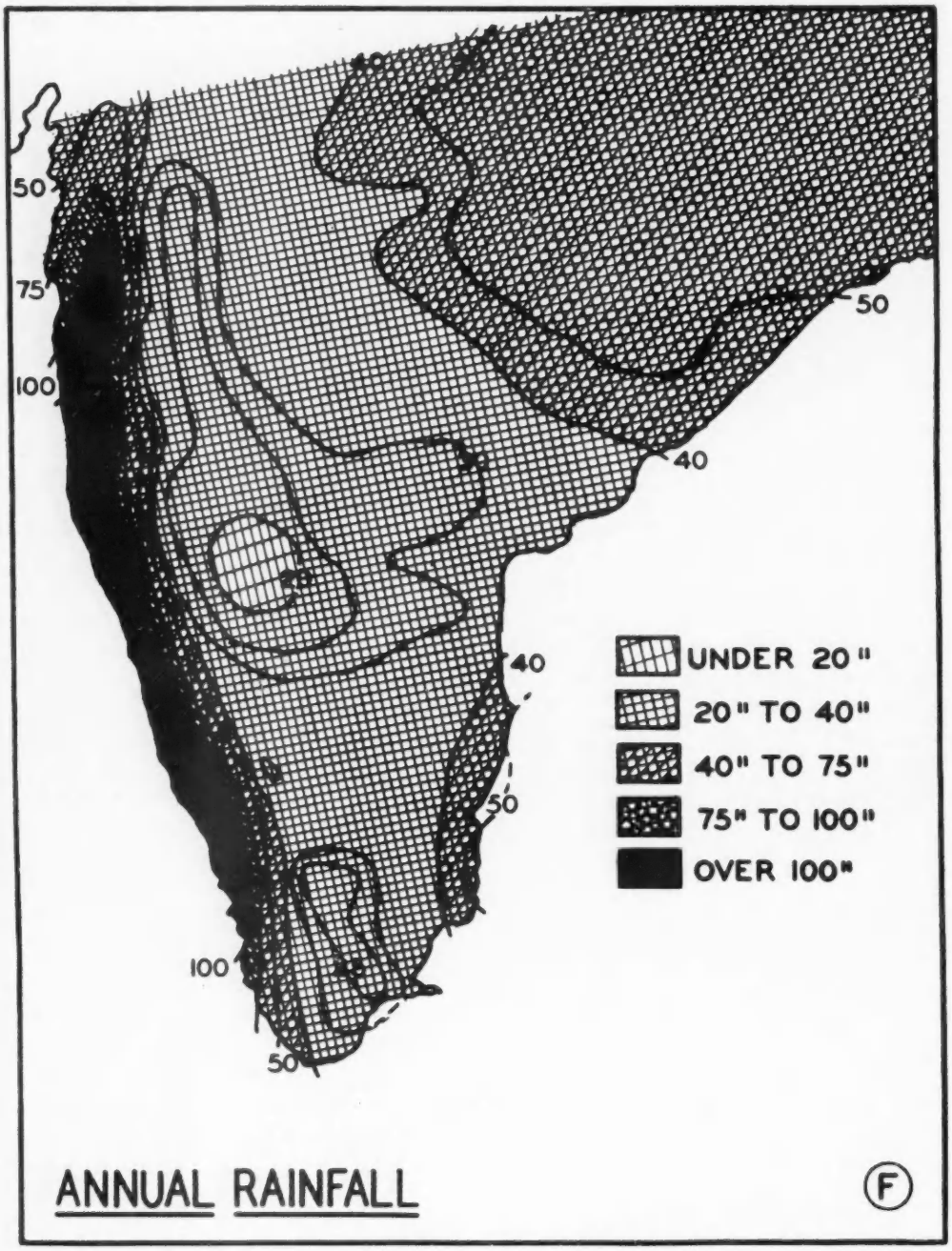


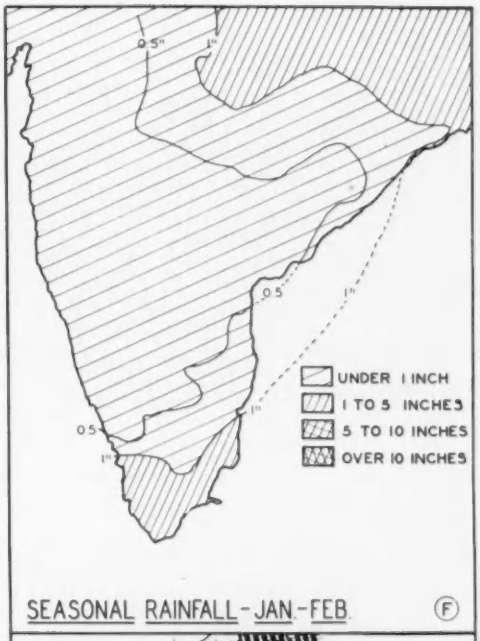
FIGURE 6.—The distribution of the amount of annual rainfall reflects strikingly the effect of the monsoons. Related to the distribution of population, this map is particularly significant.

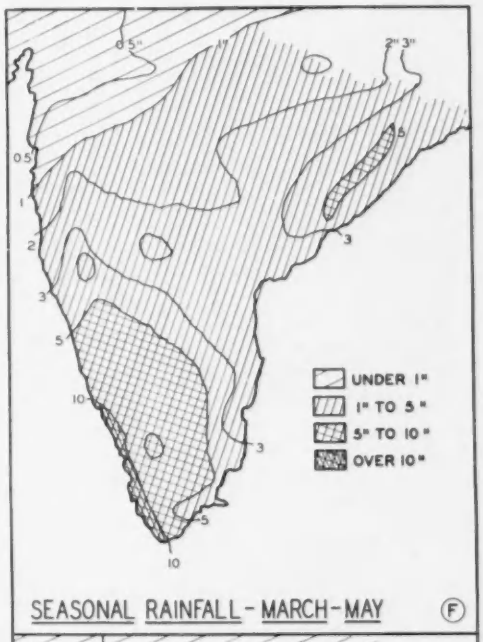
life in this region."—Extract from "Deccan Study," page 13.

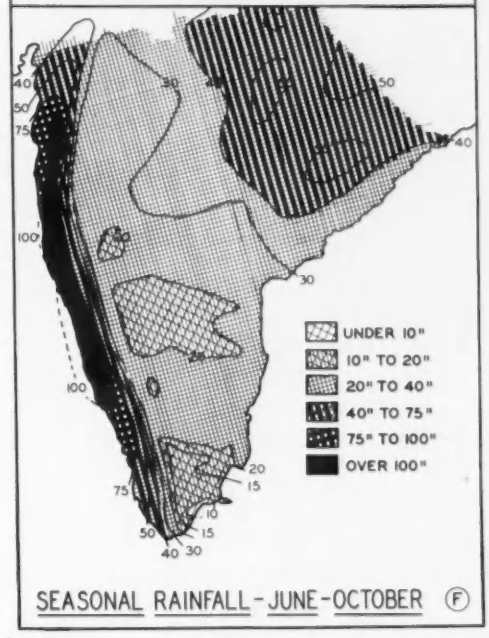
Owing to the monsoonal control, South India experiences clearly defined seasons which according to Kendrew are as follows:

A. Season of the Southwest Monsoon:

1. Mid June to Mid September—season of general rains.







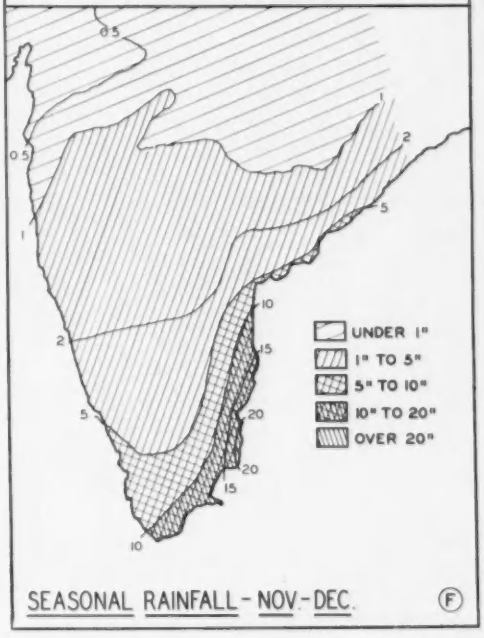


FIGURE 7.—The striking contrast between the distribution of rainfall between the height of the winter monsoon, and the height of the summer monsoon is clearly indicated by the two maps here shown. Taken in connection with the illustration on the distribution of the annual rainfall preceding and the two for spring and autumn following, they constitute an illuminating presentation of the distribution of precipitation in southern India.

FIGURE 8.—Just as the preceding map offers an interesting study in the difference of the amount of precipitation from season to season, so these two maps reveal a striking comparison between the location of the different amounts of rainfall, as they are affected by the advancing or receding height of the wet season. The direction of the winds in the several seasons is thus clearly illustrated and, related to the distribution of population, affords an even better interpretation.

FIGURE 9.—The distribution of the rainfall graph types as related to the stations where data have been collected is presented herewith and explained in the following legend. The east and west coasts are distinguished as are the different quantities and monthly distributions of precipitation.

2. Mid September to December—season of retreating monsoon.

B. Season of Northeast Monsoon:

1. January to February—cold weather season.
2. March to Mid June—hot weather season.

The plains of South India are a great contrast to the plateau in their rainfall for they are mainly regions of high and not scanty rainfall as on the latter, and furthermore they are regions of assured rains as contrasted

NUMBER	KEY	TYPE	TYPE STATION	GRAPH J F M A M J J A S O N D	ANNUAL RAINFALL INCHES
ST 1	▲	HIGH RAINFALL, MAXIMUM JULY.	DHARAMPUR		84.95
A 1A	▲	HIGH RAINFALL, MAXIMUM JULY. HIGH JUNE RAINFALL. BIG DROP IN AUGUST RAINFALL.	BOMBAY		80.38
O 1B	▲	HIGH RAINFALL, MAXIMUM JULY. HIGH JUNE RAINFALL. MAY RAINFALL OVER 2". OCTOBER RAINFALL OVER 4".	GOA		98.68
U 1C	▲	HIGH RAINFALL, MAXIMUM JULY. MAY RAINFALL OVER 2". OCTOBER RAINFALL OVER 5".	SIRSI		98.7
T 2	■	HIGH RAINFALL, MAJOR MAXIMUM JUNE. MINOR MAXIMUM OCTOBER. HIGH MAY RAINFALL. NOV. RAINFALL OVER 5".	COCHIN		113.81
S 2A	■	HIGH RAINFALL, MAXIMUM JULY. HIGH MAY RAINFALL. HIGH OCTOBER RAINFALL.	MANANTODDY		108.52
E 2B	■	HIGH RAINFALL, MAJOR MAXIMUM JULY. MINOR MAXIMUM OCTOBER. MAY RAINFALL OVER 5".	PALGHAT		78.27
W 3	♦	MODERATE RAINFALL, MAXIMUM JULY. BIG AUGUST DROP. NO MAY RAINFALL. LOW OCTOBER RAINFALL.	SURAT		41.12
T 4	◑	VERY LOW RAINFALL. MINOR MAXIMUM MAY. MAJOR MAXIMUM OCTOBER.	COIMBATORE		21.99
S 4A	◑	MODERATE RAINFALL. MINOR MAXIMUM MAY. MAJOR MAXIMUM OCTOBER.	MADURA		34.93
A 4B	◑	LOW RAINFALL. MINOR MAXIMUM APRIL. MAJOR MAXIMUM OCTOBER.	OTTAPPIDARAM		24.51
O 5	●	LOW RAINFALL. MINOR MAXIMUM APRIL. MAJOR MAXIMUM NOVEMBER. HIGH OCTOBER RAINFALL.	TINNEVELLY		27.29
U 5A	●	MODERATE RAINFALL. MINOR MAXIMUM MAY. MAJOR MAXIMUM NOV. HIGH OCTOBER RAINFALL.	TANJORE		36.02
T 5B	●	LOW SPRING AND SUMMER RAINFALL. MAXIMUM NOVEMBER.	MADRAS		49.02
S 5C	●	LOW SPRING AND SUMMER RAINFALL. MAXIMUM OCTOBER.	ONGOLE		33.6
A 6	⊙	MODERATE RAINFALL. MAXIMUM AUGUST OR SEPTEMBER. HIGH SUMMER RAINFALL.	ELLORE		35.22
E 6A	⊙	HIGH SUMMER RAINFALL. MAXIMUM OCTOBER	COCANADA		39.8 G H B

FIGURE 10.—A legend to accompany and explain the distribution of rainfall graph types of the Coast Plains on the preceding page. Each type is indicated by a distinctive symbol, and illustrated by a particular type of station for which the monthly distribution curve has been plotted.

with the uncertain ones of the Deccan. There are several definite rainfall regions on the plateau which are shown on Figure 5 constructed from graphs made from the rainfall statistics of the Indian Meteorological Department. A basal division may be made between the east coast and the west coast graphs.

WEST COAST GRAPHS

On the west the first noticeable

fact is the exceptionally high rainfall as compared with the east coast. This western area is one of the heaviest and most assured rainfall regions in India owing to the presence of the high Western Ghats which lie almost at right angles to the track of the southwest winds and very near the coast. Exceptionally heavy rains are experienced on the narrow plain and the windward slopes of the mountains. Some stations get over 100 inches, and there is never a risk of drought as in the less fortunate districts on the leeward side of the Ghats.

FIGURE 11.—Luxurious vegetation of the monsoon rain forest as found along the western slopes of the Western Ghats. It is land of this type which is cleared for the spice gardens of Malabar and the Kanaras. (Courtesy of Indian Trade Commissioner.)

This rainfall is almost wholly due to the southwest monsoon, but the tendency is for the summer maximum to become earlier proceeding southwards, the major maximum of the year being in July in the north and June in the south. The late summer rains increase in going towards the south where there gradually appears a minor maximum in October. This becomes particularly noticeable to the south of the Palghat gap, where the barrier of the Deccan no longer debars the rain-bearing winds from the northeast from reaching the southwest coast. To the northeast of Coondapur also, where the Ghat barrier is somewhat broken, a "hump" is noticeable in the graph denoting an increased October rainfall. Another fact about these west coast graphs is that the spring rains increase from north to south, this being anticipated from a study of Deccan graphs. The rains become appreciable in May from Goa district southwards. This

study does not permit of an analysis of the different rainfall régimes shown on Figures 9 and 10. It can merely indicate them.

Types 1 and 1a (Dharampur and Bombay respectively) are examples of the coastal areas of the Northern Bombay Presidency where the rainfall is high, over 80 inches, and all received in the months from June to October from the southwest monsoon. The region has neither spring nor autumn rains owing to its northerly position. Variations from this type are shown on the map as 1b and 1c, but as these do not affect the agricultural régime they are not discussed, though they are interesting from a meteorological standpoint.

In the extreme north of the Bombay plains the rains though from the southwest monsoon, are much lower owing to the absence of the Ghat barrier. The graph of Surat is typical of this region. Its rainfall is but 41.2 inches received from June to September, but this lower rainfall is more than compensated for by the first-class regur soils found throughout which permit of a cool season as well as a rainy season crop. This is one of the richest agricultural areas of Bombay.

The graphs included in Type 2 are found along the west coast to the south of Type 1. Their rainy season is longer, for though the main rains are brought by the southwest monsoon, they benefit from the spring rains or "blossom showers" which are found throughout southern India, and further receive rains from the northeast monsoon in the fall. This is due to the decreased height of the Ghats, particularly to the south of the Palghat gap. The graph for Cochin is typical of these regions and minor variations are found in Types 2a and 2b.

Effect of Rainfall Régimes on the Agricultural Year

In all parts of the west coast the main agricultural season is from June to October being dependent on the southwest monsoon. In the extreme north of the western plain crops can be grown only during this season, save where irrigation or regur soils are present. The latter allow of both rainy and a cool season crop in the areas round Broach and Surat.

FIGURE 12.—Agricultural practice in India is at a low level. The peasant uses primitive wooden implements like the plow shown in the photograph, and his work animals are poor and ill-nourished owing to paucity of fodder. Each village has its waste land for grazing but the grass is poor and is only supplemented by millet or rice stalk. Improvement in cultivation can only come from an improvement in both implements and work stock. (Courtesy of Indian Railways Bureau.)

In the southern part of the west coast, the influence of the spring and late season rains greatly extends the length of the agricultural year. Particularly are the spring rains significant. They are termed in the coffee districts "blossom showers," for it is on them that the flowering of the coffee, and hence the fruiting, depends. Moreover, they come at a time when the tanks, which are the main type of irrigation in these regions, are almost entirely empty after the dry season, and thus bring very timely relief to the farmer. If there

is a little water left in the tanks from the previous season, the ryot (peasant) will manage frequently to grow an early season crop if the spring rains are good enough to supplement the tank water. Thus, there is practically no dead season in the agricultural year of the south as there is in the north. The southern ryots have a year-long job with their rice fields and spice gardens. As a result they show very negligible figures of emigration either to the factories of the towns as do the ryots of the northern section of the plains, or to the Burmese, Cingalese, or Malayan rubber and tea plantations as in the Madras plains. This is an incalculable benefit to the region and illustrates how the rainfall régime penetrates the whole structure and morale of village life in India. The periodic emigration to the factories and plantations due to the dead season in agriculture is one of the greatest evils with which improvers of Indian agriculture have to contend. It means that for long periods the fields are left untilled and uncared for, and as the farmer spends so much of his time away from them he is not able to do thorough cultivation in the short time he is there. Thus his fields are exhausted, his crops poor, and cultivation is at the lowest possible level.

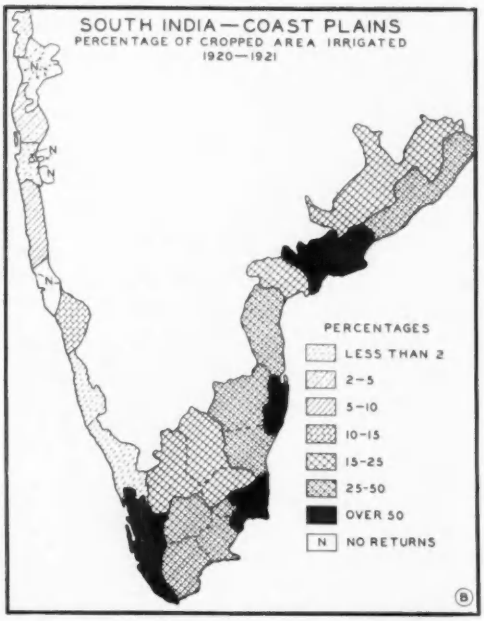


FIGURE 13.—The percentage of crop area irrigated on the Coast Plains of South India is graphically represented by this map of distribution. Taken in connection with the following map of the types of irrigation, the watering of the crops in these coastal areas can be comprehensively studied.

EAST COAST GRAPHS

As in the case of the west coast, the graphs of the East exhibit certain common features in spite of the great variation between north and south. The amount of rainfall is lower than for the west coast stations as befits a region on the leeward side of the chief rain-bearing winds, and throughout the major falls of the year occur in the late summer and autumn months proving that it is the northeast and not the southwest wind régime which dominates the rains of the east coast. Most stations however receive rain also from the southwest monsoon.

The chief characters of the east coast graphs are as follows:

1. The rainfall from the southwest monsoon decreases in going from north to south (cf. graphs for Cocanada and Madras).
2. The rainfall from the northeast monsoon increases in going from north to south. Thus, the southern stations have a late summer or autumn maximum (see graphs for Ellore and Madras).
3. The amount of rainfall is greatest in the north where the benefit of both monsoons is received.
4. Spring rains are absent in the north of the region but increase towards the south. In some southern stations there is a minor maximum in April or May (see graphs for Tinnevelly and Tanjore).

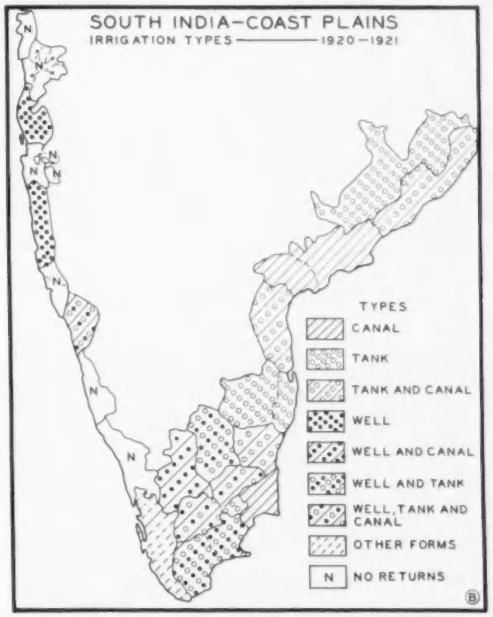


FIGURE 14.—The types of irrigation used for the watering of the crops on the coastal plains of South India include canals, tanks, wells, and combination of these, with secondary or minor types, which are usually modifications. As in the previous map, some sections have yielded no returns for graphic representation.

Influence of the Rainfall Régimes on the Agricultural Year

These rainfall régimes have a definite influence on the agricultural year of the eastern plains as they do on the western. The chief cropping season on the Madras coast is in late summer and autumn in contrast to the early summer season of the west. Also, proceeding southwards the cropping season becomes later as the maximum falls of the year occur later. Spring rains in these southern districts permit of an early season crop as they do on the west coast. But though the rainfall in the south is spread over a larger season than in the north, it is considerably lower in amount, and these areas are some of the driest in the Madras Presidency. They receive little or no benefit from the southwest monsoon and are too far south to get much from the northeast monsoon.

In Tinnevelly, as an example, the rainfall is only 27 inches as compared with 49.02 inches for Madras, a little to the north of it. This low rainfall region extends all over the upland regions of Madras on the edge of the Deccan from Chittoor district in the north to the Cardamom hills in the south. It is fortunate that there is in this region much regur soil well suited to agriculture in a dry area, and also the great irrigation system of the Tanjore delta. Both these compensate in a large measure for the deficiency of rains.

The southern region of Madras because of the agricultural limitations resulting from the low rainfall has not the all-round agricultural year of the southwest coast. This fact combined with the great density of population (442 per square mile) results in a continuous and great emigration to either the factories of Bangalore and Madras, or to the Malayan, Cingalese, and Burmese plantations, thus decreasing considerably the standard of agricultural practices.

The graphs of rain days which have been plotted over the rainfall graphs show that even more than in the case of the Deccan, the rainfalls experienced are extremely heavy, 1½ inches per day being received in July in some of the west-coast stations. The feature of very heavy falls with breaks between is apparent also on these plains as on the plateau, but owing to their high rainfall, the breaks do not bring such disastrous results in drought and failing of crops as they do on the Deccan. Indeed, excessive rainfall may sometimes be a greater evil than drought, as is evidenced from the following account of the season 1924–1925 in the Madras

Presidency. "The monsoon rains were rather heavy . . . floods seriously damaged communications and irrigation works, dislocated railway traffic for about a month, washed away houses, crops (especially paddy), and fodder stocks, and silted up thousands of acres of 'wet' [irrigated] lands mainly under paddy in portions of Malabar, Trichinolopy, and Tanjore, rendering them unfit for cultivation."

Heavy rains in the Godaveri region due to cyclonic storms also damaged the crops. This bears out the statement made by Blandford in 1889 and quoted at length in the Deccan study that Indian rains are not as valuable for their amount as they might be, since often they scour the land instead of watering it, owing to their heavy nature.

The Indian cultivator has then, in order to utilise the rainfall to its best advantage, to protect against excessive falls by terracing, field embankments, and like methods, and secondly to conserve the excess from these rains in order to utilise it in time of drought. This leads to a discussion of irrigation in relation to soil and climatic factors.

FIGURE 15.—Lifting water from a well. Sometimes a slope is made down from the well and a bullock is harnessed to the rope. When it walks down the slope, the bucket comes up. Well irrigation is common in the trap country as there is much subterranean water in fissures in the rock. Tank irrigation is not practicable on the lava plains as they are too flat. (Courtesy of Indian Trade Commissioner.)

IRRIGATION OF THE COAST PLAINS IN RELATION TO AGRICULTURE

The irrigation of the plains offers a great contrast to that of the drier Deccan plateau. The west coast has such high and assured rains that little irrigation is necessary. So

plentiful is this rain that the chief activities of the region are not so much to conserve the rainfall, as to conduct it to the right channels, and to prevent it from scouring the lands. This is evident in the south, taking Travancore and Cochin as typical, where the irrigation works are channels and field embankments. Further north these are used in intensely cultivated spice gardens for which Kanara is famous.

To the north in the Konkan districts of Bombay the area irrigated is slight and is done from wells. This is due to geological features, for the well type of irrigation is associated all over South India with the trap country, which has a level surface unsuitable for tanks, and which has frequently a subterranean water supply in fissures in the rock.

In the northern districts of the west, the low percentage of irrigation is due to the regur soils which, as those on the plateau, are heavy and retentive, and act as natural reservoirs for water. The higher percentage of irrigation in Ratnagiri district is due to the trap here being overlaid by porous dry lateritic soils which require constant watering if they are to be productive.

In Kanara, where the metamorphic rocks with their rugged contours and lack of subterranean water supply replace the trap, the tank is the chief type of irrigation. Tanks are formed by blocking up natural depressions in the ground to conserve water, and it will be seen from the irrigation map that almost all the metamorphic rock areas of South India are irrigated from tanks. Practically every village has its tank, some of them being many hundreds of years old. They are small, irrigating only a few acres, and from them is derived the water

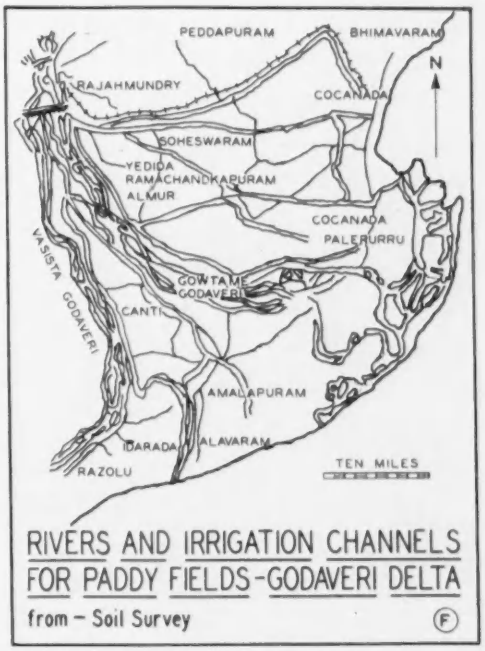


FIGURE 16.—Much of the agriculture in India is dependent upon a complicated and elaborate system of irrigation, fostered and supported by the government.

of the village for washing and cooking. These tanks are dependent on the rains, which is the second explanation of the fact that they are so universal in the metamorphic country where are found the heaviest and most assured rains of the peninsula. The tanks are filled during the rainy season, and on the water conserved in them the crops and cattle depend until the next rainy season fills them again. The Government irrigation tanks, which are huge reservoirs irrigating hundreds of acres, are fed from perennial streams flowing from the Ghats.

The east coast is differentiated at once from the west coast by the fact that from north to south it shows a high percentage of irrigation. This is due to several factors. Firstly, it is a region of lower rainfall than the west and irrigation is more necessary. Secondly, it is almost wholly a region

of red soils. These as pointed out in the soil section are not retentive like regur, and require continual watering during the dry weather to make them productive. In many parts the amount of lateritic soil intermixed is great, which increases their dryness considerably.

Thirdly, and this fact is one of the most dominant on the east coast, owing to the great deltaic systems of its origin far back in the mountain region where the Periyar River rises. Periyar Project.—"Briefly stated it consists in damming up the Periyar River, which formerly ran useless down to the west coast through country which already had a sufficient supply through rainfall, and turning it through the western Ghats by a tunnel down the East side of that range where water for irrigation

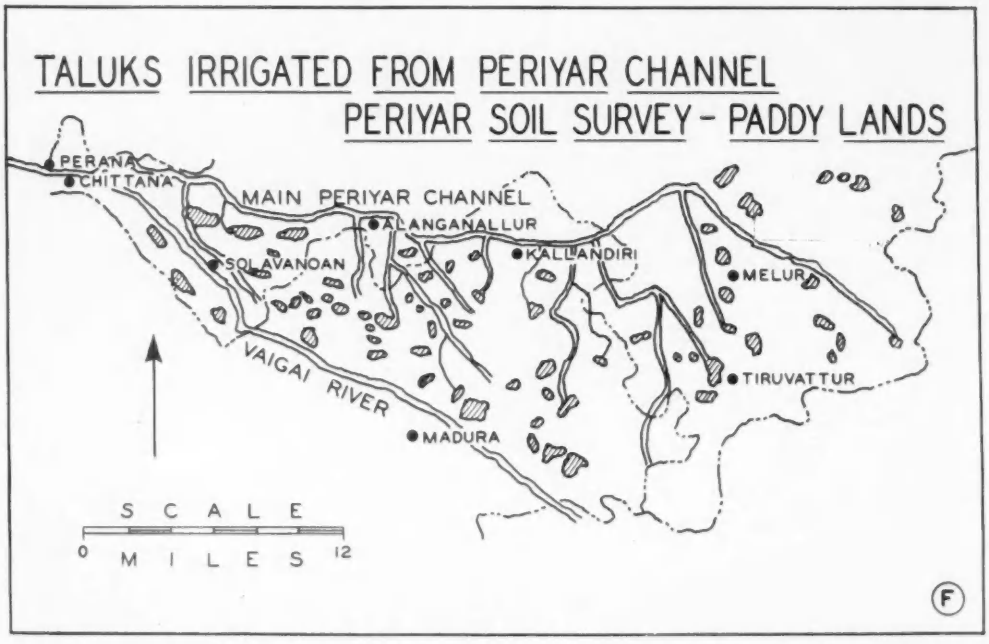


FIGURE 17.—The elaborate and scientific organization of the irrigation in India is illustrated by the Periyar Channel Project.

the Godaveri Kistna and Cauvery, a type of irrigation little seen on the west coast—that by canals—completely dominates the irrigation of the deltas. The Figures 16 and 17 show how intensively canal irrigation is carried on in these delta lands, so that every small area has its channel with which to feed its paddy field. The Periyar system, which develops the Vaigai River, is a similar one to that found in the Godaveri and Kistna deltas, though the project has was the one thing necessary to the prosperity of the country."—*Gazetteer*, Madras. Also important are the systems of canals along the Cauvery Valley. These two latter projects are particularly significant for the area served by them is the dry district of the Madras Presidency.

The percentage of irrigated area in the deltas is extremely high. In the Tanjore delta, for example, the proportion of irrigated land to cultivated is 73.9 per cent. This is typical of

FIGURE 18.—Most of the rivers on the plains are used for irrigation. This shows a primitive method of raising water in scoops across an embankment in Tanjore (Madras). (Courtesy of Indian Trade Commissioner.)

the three deltas where practically all the cultivation is "wet" paddy land. Elsewhere on the east coast the irrigation is mainly by tanks, especially in the hilly country of the Agency districts, Nellore, Chittoor, and North Arcot.

Almost throughout the plains there

FIGURE 19.—Government irrigation enterprises are on a large scale. This shows the Nandamur Aqueduct and the Nellore Canal in the Godaveri Delta. Land watered from Government canals constitutes eighty per cent of the land irrigated in Godaveri District. Practically all of it is used for rice. (Courtesy of Indian Trade Commissioner.)

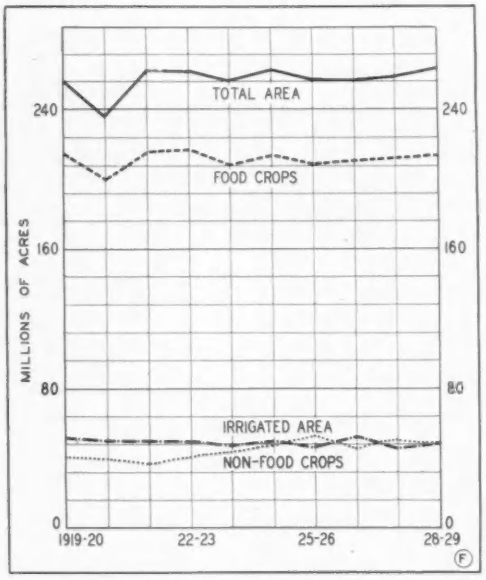


FIGURE 20.—Total area sown, total area under food crops, total irrigated area sown, and total area under non-food crops in British India. The overwhelming importance of native food crops in India, which occupy 211 million acres out of 262 million acres sown, is shown here. (From "Agricultural Statistics of British India, 1928–1929.")

is the absence of the terrible possibilities of famine which threaten so much of the Deccan. The only area likely to be affected is the dry southeast part of Tinnevelly, Coimbatore, and Salem, and it is apparent from the map that this region has been irrigated to prevent such calamity to some extent. Also, in parts of these areas regur soils are the natural conservers of water, and are invaluable in this dry region which has heavy rains at one season only.

A SUMMARY OF THE DISTRIBUTION OF THE CHIEF CROPS OF THE COAST PLAINS AS DETERMINED BY SOIL AND RAINFALL CONDITIONS

FOOD GRAINS FOR NATIVE CONSUMPTION

RICE

Rice is overwhelmingly predominant over any other crop on the coast plains for two reasons: firstly, the population is so dense that the land must of necessity go under a food crop, and secondly, there are found here almost ideal conditions for its growth—rich soil, high temperature, and a plentiful water supply either from the rains or from irrigation. Rice is favoured by the Indian peasant as a food above all other grains. This is evidenced by such Indian customs as scattering powdered rice over the bride and bridegroom to give prosperity. Rice is also offered an Indian at the birth of a child. It is grown on the richest soils of the lowlands as on the poorest ones of the uplands. These latter will grow only unirrigated crops of "hill rice" which is sown broadcast and matures in 100 to 120 days. It is the food of the poorer peasants only. The upland varieties of rice have a short coarse opaque grain while the lowland rice has a longer and finer one. In the richer lowland

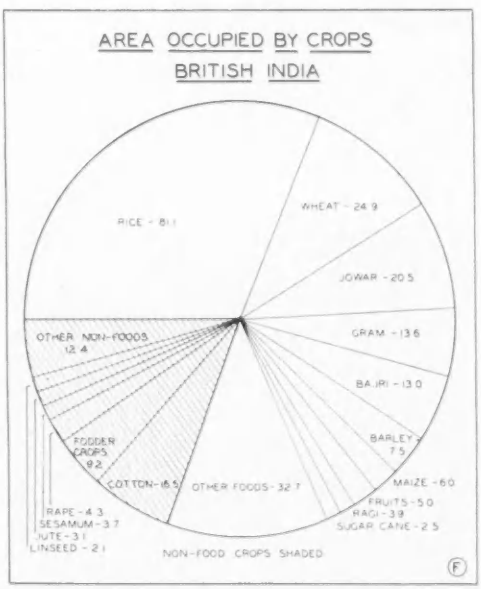


FIGURE 21.—Area occupied by different crops in British India, 1928–1929. The non-food crops are shaded. (From "Agricultural Statistics of British India, 1928–1929.")

areas the rice is grown both as an irrigated and an unirrigated crop on the first- and second-class red loams and lateritic soils. Here it is always transplanted and takes from 120 to 180 days to mature. In many parts, particularly where forest areas are near and green manure, humus, or wood ash can be found, it is heavily manured. Birdwood in "Sva" notes every bit of manure possible is collected to manure the rice lands. "Hindoos habitually use manure in the cultivation of rice; sometimes in the hot season the land is strewn with all the rubbish and refuse of the household and homestead, floor sweepings, old thatch and old clothes being burned together in the fields. When the rains set in this mess is trodden in by men, women, and children, assisted by cows and buffaloes until the whole is kneeded into a plastic cohesive mud called 'chikal,' in which the seed rice is sown. The effect of this is to make the ground immediately below the upper layer of fertile mud into an impervious bottom which prevents the rain draining through and escaping."—Quoted by C. E. Douglas, in "Rice." This is necessary since in many of these lowland rice lands, more than one crop a year is grown. The principal one is during the rainy season, but where irrigation is practised, two, and in rare cases three, crops are obtained. On the east coast, crops are grown from both the southwest and the northeast monsoons but in the southern part the chief crop is the later one.

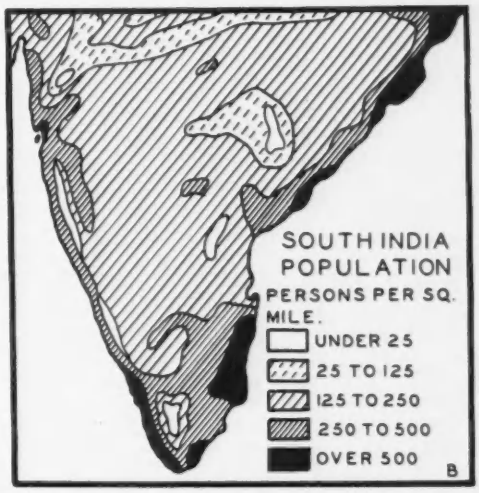


FIGURE 23.—The distribution of population of South India indicates the dominating influence of the distribution of rainfall, and secondarily reveals the effect of relief.

FIGURE 22.—All the east coast districts are in the Madras Presidency and also Malabar and South Kanara on the west coast. Coorg, Cochin, and Travancore, and the smaller areas shaded on the west coast are native states and the rest of the west coast from North Kanara northwards, is the Bombay Presidency with the exception of Goa which is Portuguese. This is a key to the distribution maps.

In the northern part of the west coast the summer crop during the southwest monsoon is the only one of the year, but to the south the rains are sufficient for a second crop. In the regions of appreciable spring rains a third crop may sometimes be grown if the tanks have any water

left in them after the dry season. Rice is often rotated with other crops, a favorite one being sugar cane. Also a second crop of pulse or millets is often grown on rice land without further watering.

Distribution

The eastern limit of rice cultivation on the west coast is that of 50 inches annual rainfall which is on the leeward side of the Western Ghats.

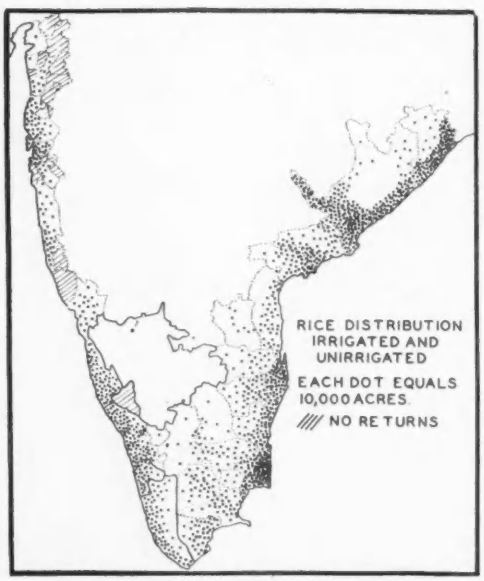


FIGURE 24.—Rice is the chief food grain of the plains, and occupies the best soils throughout. On the west coast with its high rainfall, it is unirrigated, but on the east it is irrigated and shows great concentration in the deltas of the Godaveri, Kistna, and Cauvery rivers with their great canal systems. It is noticeably absent from the black soil areas where jowar millet replaces it, and its acreage decreases also in the inland districts of Madras where the rainfall is low and there is not plentiful irrigation.

Owing to the heavy rainfall along the coast irrigated rice is practically unknown and the unirrigated varieties produce as much per acre as do the irrigated varieties of the east coast (see Figures 25 and 26). In the extreme north of the west coast there

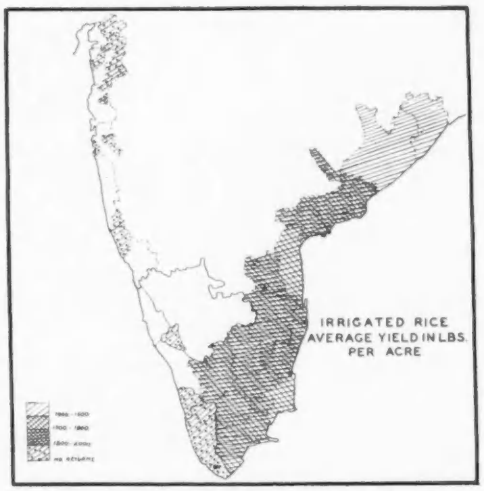


FIGURE 25.—Owing to the high rainfall of the west coast, rice is never irrigated, but on the east coast where the rainfall is below 50 inches, and where the great canal systems of the Godaveri, Kistna, and Cauvery deltas offer exceptional facilities for its growth, rice is almost entirely an irrigated crop with a high yield per acre. (Shaded areas are native states with no returns.)

is little cropping on the heavy regur soils and lower rainfall regions of Broach and Surat, and cotton and

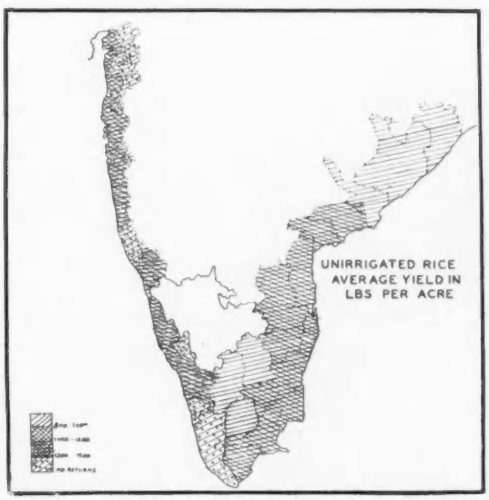


FIGURE 26.—On the west coast rice is rarely irrigated owing to the high and assured rainfall, yet the yield per acre is almost as high as that of irrigated rice on the east coast. The unirrigated rice of the east is well below the irrigated rice in yield, especially in the inland districts of Madras where the rainfall is less than on the coast. The figures here probably refer to upland rice, a poor and coarse-grained variety usually grown unirrigated.

jower millet replace rice in importance. Because of the longer rainfall season of the southerly areas the cropping of rice is much heavier than to the north and, owing to pressure on the land, much of the low marshy coast has been reclaimed and produces satisfactory crops. The densest cropping of rice is found on the eastern plains in the great deltas. It is chiefly irrigated rice owing to the moderate rainfall and the splendid facilities offered for irrigation by the deltas of the Godaveri, Kistna, and Cauvery Rivers. Irrigated rice yields 1,000 to 1,500 pounds per acre here as compared with 400 to 800 pounds for unirrigated rice. Figures 16 and 17, showing the canal and tank systems of the Godaveri delta and the Vaigai and Periyar paddy lands, give some idea of the type of land which is found here. That the irrigated land is almost wholly devoted to rice is proved by the following statistics. The percentage of cultivated area irrigated in the Godaveri district is 69.7 per cent. Of this 76 per cent is under rice. In Kistna 55 per cent of the cultivated area is irrigated (this being practically all in the delta) and 95 per cent of this is under rice. In Tanjore, which is the Cauvery delta, 74 per cent of the cultivated area is irrigated (again chiefly in the delta) and all of this is under rice.

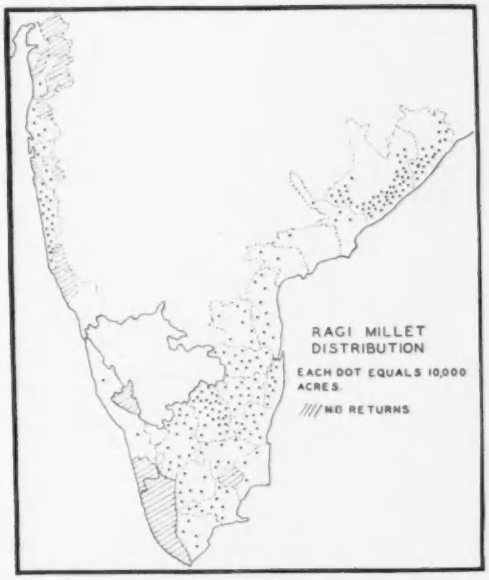


FIGURE 28.—Ragi is the chief crop in regions of high rainfall and poor soils; hence it is found in the rice regions as a supplementary crop. Its acreage shows increase wherever there is an increase of poor soils as in Ratnagiri district, Bombay Presidency.

FIGURE 27.—Transplanting rice. The lowland varieties of rice are always transplanted. The poorer upland rice is sown broadcast. (Courtesy of India Railways Bureau.)

These delta lands have been described as "an interminable sea of

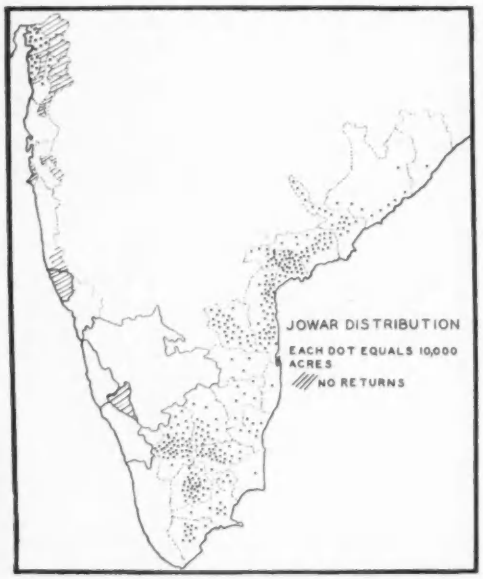


FIGURE 29.—Jowar or great millet is the staple food grain of regions where it is too dry for rice, and in these regions it is grown on the best and heaviest soils. Like cotton it flourishes on the "regur" or black cotton soils as is evidenced by its concentration where these soils occur in Broach and Surat (Bombay) and in parts of the Madras Presidency. In the eastern delta regions, it is often grown as an irrigated crop for its stalk is a highly nutritious fodder much needed in the rice lands. It is absent from the high rainfall regions of the west coast.

green and golden rice fields dotted with villages and surrounded by palm trees," and of the Godaveri delta in particular—"From the dam at Dowlaishwaram to the sea this is one mass of rice fields. During the rains it is one great sheet of water with the roads and villages standing out. Later in the year as the rice grows higher the dividing boundaries are hidden, and the whole country looks like a single rice field, only the palm trees along the edges of the fields, the groves around the villages, the road avenues and the white sails of boats gliding along the main canals breaking the uniform sea of green waving crops."—*Provincial Gazetteer*, Madras.

Away from the coast and deltaic areas the cultivation is not great. In the Agency districts of Ganjam, Godaveri, and Vizagapatam, there is densely forested mountain country inhabited chiefly by wild tribes who pursue shifting cultivation. Similarly, along all the slopes of the Eastern Ghats, rice shows only scanty cropping as compared with the plains. In the southeast parts of Madras in Coimbatore, Salem, Madura, and Tinnevelly, three factors combined account for the decrease in rice cultivation as compared with the coastal area. Firstly, the rainfall is the lowest for the coast areas of the Presidency, being in most parts little over 30 inches. Secondly, much of the country in the west of these districts is hilly. Thirdly, these are the chief regur areas of Madras, and jowar and cotton are the principal crops. It will be noticed here that belts of rice cultivation extend along the Cauvery and Vaigai Rivers where irrigation is available.

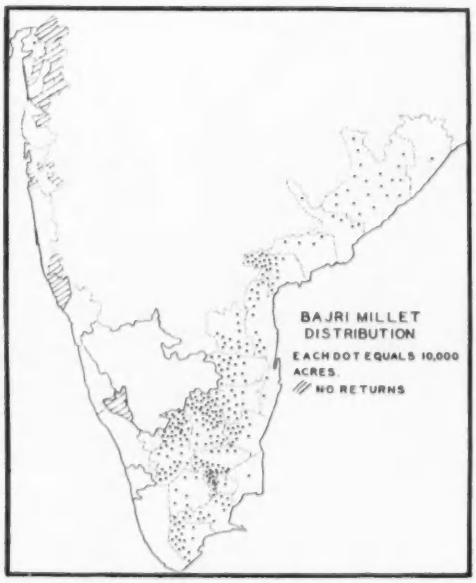


FIGURE 30.—Bajri is the millet crop of poor soils in low rainfall regions and is a supplementary crop to jowar. Neither bajri or jowar are grown as extensively on the plains as on the drier plateau.

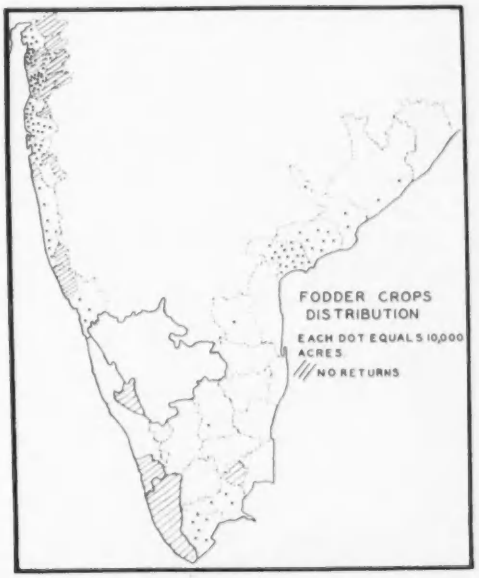


FIGURE 31.—South India is deficient in stock feed for the grazing is not good and there is little land to be spared from food crops. The chief fodders are millet and rice stalks. Jowar yields a nutritious stalk, but rice straw is poor. Hence it is in the delta regions where much rice is grown that the growth of fodder crops like lucerne and irrigated jowar is receiving most attention as this map will indicate. The northwestern plains of Bombay are also progressive in this respect.

MILLETS (RAGI, JOWAR, AND BAJRI)

Ragi is a hardy millet which grows in regions of poor soils and heavy rainfall. It is thus a supplementary crop to rice, using land on which the latter will not grow. Wherever the percentage of poor soils increases in the rice zone, the cropping of ragi increases, as may be seen in the lateritic areas of Ratnagiri district, Bombay Presidency.

Jowar or great millet, which is the predominant food grain of the Deccan with its low rainfall and regur soils, is of little importance on the plains with their light soils and heavy rainfall. Yet it will be noticed that it is significant on them in that it fills in all the blanks on the rice map where the areas of regur soils and lower rainfall (under 40 inches) occur in the northern Bombay Presidency and southeast Madras. In these places it is the chief food grain, occupying the best soils.

Bajri is the supplementary millet to jowar, as ragi is to rice, for it grows on the poorer soils in the low rainfall regions. Thus these four grains supplement one another on the plains. Rice is the crop of the rich soils in regions of high rainfall or good irrigation. Jowar replaces it on the rich soils in low rainfall regions. On the poor soils in heavy rainfall regions, ragi is grown, and in similar soils in low rainfall regions bajri takes its place.

Every part of the plains thus has its food grain and its fodder crop, for all these grains yield stalk for fodder since the latter is indispensable to the ryot. Fodder crops come second only to food grains in importance.

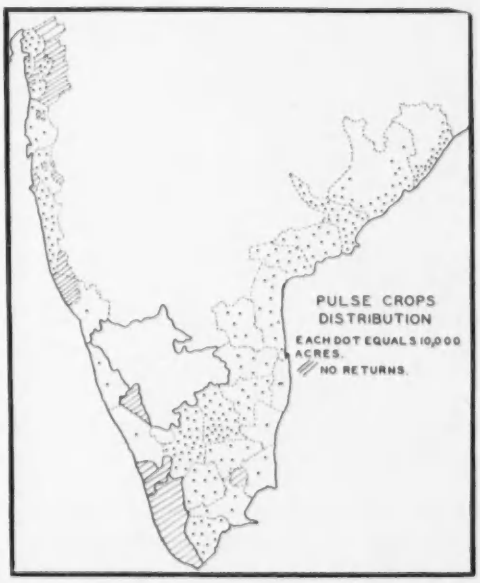


FIGURE 32.—Pulses are indispensable food crops throughout India and are grown on both rich and poor soils. They are frequently sown along with another crop or as a second crop after rice. Gram is the commonest pulse grown. Note the low acreage under pulses in the rich rice lands and the increase in acreage in the drier districts of Coimbatore and Salem, and the poor soil region of Ratnagiri.

Rice stalk yields the poorest fodder, and some attempt to remedy the deficiency is shown by the growth of fodder crops, chiefly lucerne and irrigated jowar, in the Godaveri delta and the Konkan district of Bombay, where most of the area is under rice (see Figure 31).

PULSES

These are grown mainly on the poor soils intermixed with the millets, and are often a second crop after rice without further irrigation. They are not, however, as extensively cultivated in the regions of high rainfall as they are on the drier plateau. The distribution of all pulses is shown on Figure 32.

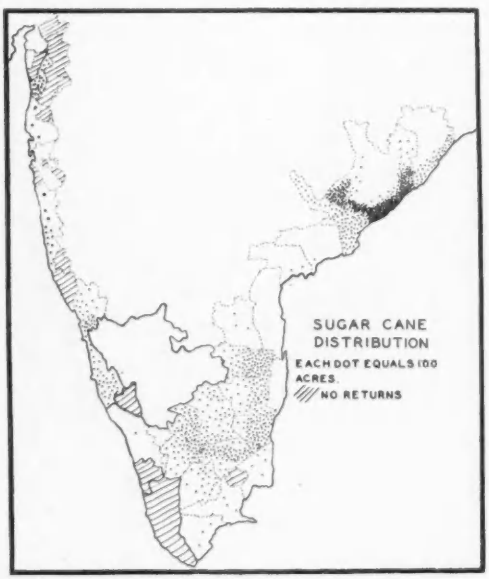


FIGURE 33.—India has about half the world's acreage of cane sugar, yet has to import large quantities owing to the low yield of sugar per acre which is about one-third that of Cuba, one-sixth that of Java, and one-seventh that of Hawaii. This is due to many factors which are discussed in the text. The large acreage in the northeast region of the Madras plains is partly due to the energies of the Agricultural Departments in extending and improving the crop.

SUGAR CANE

This crop is grown throughout India for home consumption, and it is a crop of the rich cultivator since it has heavy demands for its growth. It must have exceptionally rich lands, and both heavy and light soils suit it, provided they are well manured, for it is an exhausting crop. Further, it requires a high amount of water either from rainfall (70 inches) or from irrigation. It is evident from these conditions that there are wide areas of the plains which would be eminently suited to its growth, and yet the distribution map shows that the area under sugar cane is not great. Of all the irrigated area of Madras in 1928–1929, only nine-tenths of 1 per cent was under sugar cane, as compared with 83 per cent for rice. The reason lies in several factors, which the Indian Sugar Committee think will militate against any extensive sugar-cane growing in the future.

Firstly, the cane requires not only exceptionally rich land, but heavy manuring. As manure is scarce in the peninsula it is also dear, and this makes the growing of cane beyond the means of the ordinary ryot. Secondly, the cane occupies the land during nine to twelve months and is a most exhausting crop, so that unless the ryot has much good land he cannot spare his best for a lengthy time to grow a crop like sugar cane. Further, the crop requires so much water that it is rarely grown in the peninsula save on the west coast unless irrigated practically all the year. As before noticed, wherever the ryot has good irrigation facilities, he grows rice first and foremost, and other irrigated crops follow a poor second. Thus it is that sugar cane is not cropped so extensively as physical conditions might warrant.

In the regions where it is grown it

is usually a rotation crop with rice on "wet" land or a rotation crop on the garden land. It suffers being in the delta areas, since the rice lands are flat and marshy and not easily drained. Cane likes well-drained soil, and suffers in consequence. Its distribution, though not intense on the plains, extends along the whole of the west coast where it can be grown great concentration in Chittoor and North Arcot districts, and in the delta of the Godaveri and the coast north of it. In both these areas cultivation is not only due to the suitable physical conditions, but also to the enterprise of the agricultural departments who have introduced new foreign varieties of cane, and are instructing the ryots to grow them.

FIGURE 34.—A power crusher in a sugar cane mill in the Godaveri delta. The sugar produced in India is known as "Gur" and is practically concentrated cane juice containing all the molasses. Gur does not yield more than fifty per cent of refined sugar as compared with an average of ninety per cent for other countries. This is partly due to the methods of growing the cane, and partly to inefficient methods of milling. Agricultural departments in the cane growing areas are doing all in their power to introduce power crushing mills instead of the native bullock driven ones. The strain on the bullocks in the latter type is great and only the low percentage of juice quoted above is extracted. "Moreover the deterioration of the cattle owing to the heavy demands put upon them presents a serious obstacle to the introduction of better methods of cultivation." (Report of the Indian Sugar Commission, 1920.) Large power plants will not be profitable because of the scattered nature of the cane growing areas and the difficulty of getting a sufficient supply from them. Attempts are therefore directed to introducing power crushing with small plant, such as is shown. (Courtesy of Indian Trade Commissioner.)

unirrigated on account of the heavy rainfall. Indeed, here the big difficulty in its cultivation lies in the keeping of the land well drained under the heavy rainfall conditions, since the sugar cane is spoiled if the ground becomes water logged. On the east side of the plains it shows its Half of the cane grown in Madras comes from the Godaveri delta. It suffers, however, since it is grown in small scattered patches all over the rice lands, and the soil is too damp and ill drained for a really good crop. A noticeable feature of cultivation here is the method of tying up the

FIGURE 35.—Date palm and palmyra palm supply sugar in India in addition to sugar cane, and a comparison with the sugar cane map will show that they are supplementary to cane sugar. Of this "other sugar" acreage the Madras Presidency has fifty-one per cent of India's total. Most of the rest is in Bengal.

canes, since the cyclonic storms so prevalent often flatten them down.

The energies of the Agricultural Departments are not only devoted to extending the area under cane, but also to making the cane give a higher yield if possible, and to increasing the sugar obtained by introducing into India modern sugar-crushing machinery. The yield of cane in India is only 1.07 tons per acre as compared with 4.12 tons in Java, where the sugar industry has been highly developed by the Dutch. Further, owing to the defective crushing, India gets only 50 per cent of refined sugar while other countries get as much as 90 per cent. The sugar mills could only be established if a sufficient supply of cane were guaranteed within the area in which the factory was situated. To get this guarantee from all the scattered and periodic sugar cane lands is impossible in most areas of South India; hence no manufacturer is likely to make a big capital outlay on a mill. The most successful areas in South India, as noted in the Deccan study, are the great canal areas of the West Bombay Deccan where, owing to concentration of the sugar-growing industry lands round the great canals the factories may prosper. Some factories are found in the densest cropped areas of Madras, but the old native sugar crusher is mainly used and the yield of sugar is therefore low.

The sugar cane is not the only plant which yields sugar, and these "other sources" are shown on Figure 35. They are chiefly various kinds of palms such as the palmyra, date, and coconut, and it is noticeable that they are somewhat supplementary to sugar cane particularly in Malabar, Tinnevelly, Ramnad, and Tanjore. The sugar in these trees is extracted

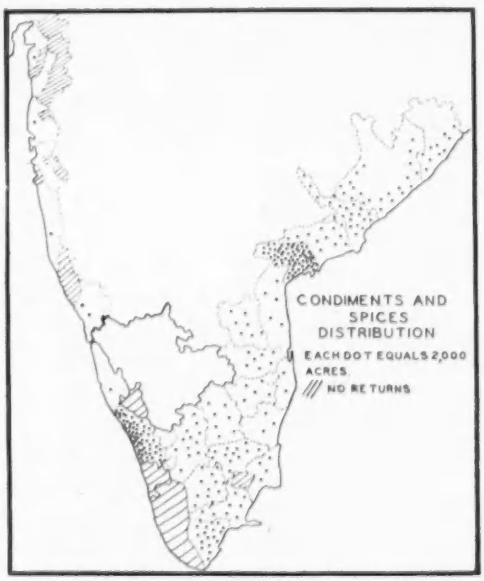


FIGURE 36.—The growth of these crops is a typical "garden" form of cultivation and the acreage is not high though the crops are very profitable to grow. The most famous spice gardens are in the southwestern section of the plains in Kanara and Malabar.

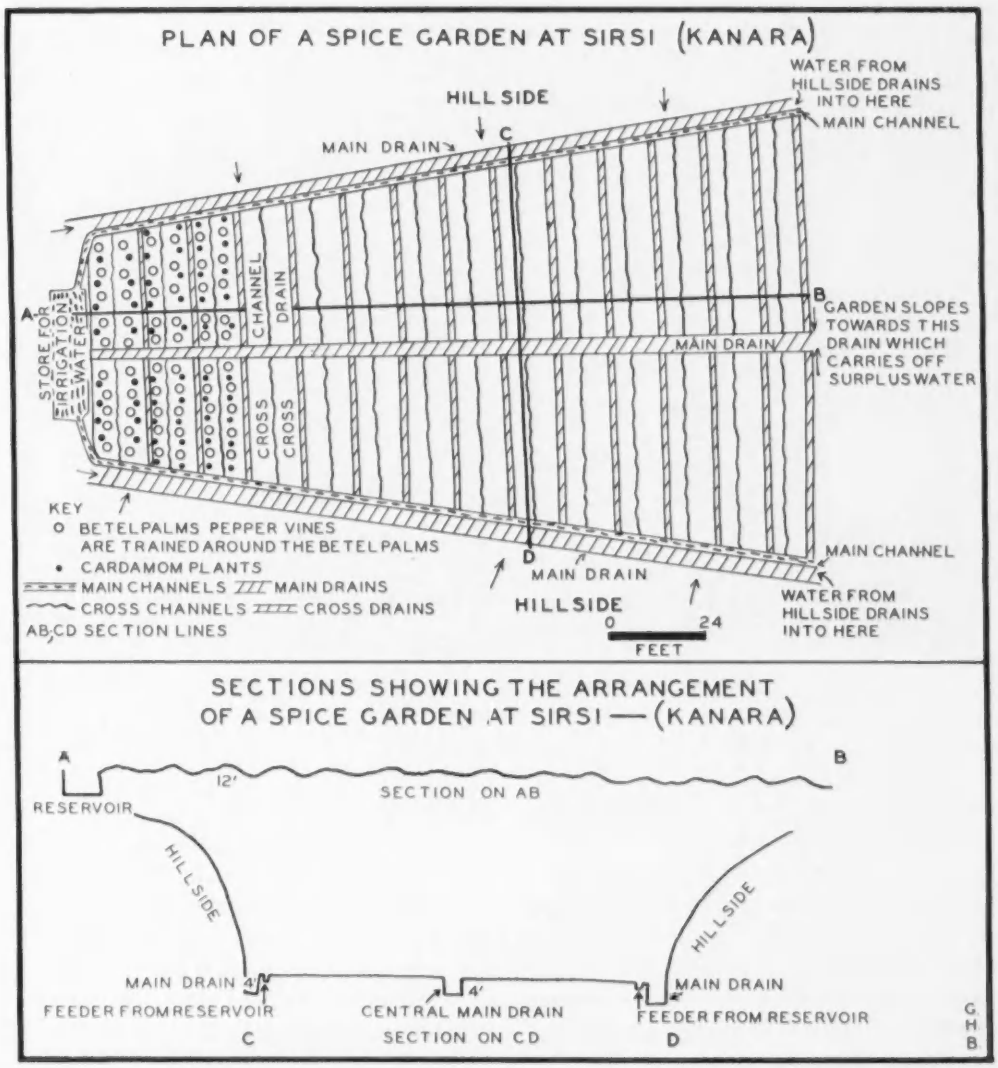


FIGURE 37.—The careful, methodical way in which a spice garden is planned and laid out indicates how thoughtfully the adjustment of agricultural use of the land in relation to its character must be.

from the juice obtained by tapping, but although these types of sugar are used a good deal by the natives in the making of gul, none of them have been developed at all commercially in South India though the matter has been investigated.

GARDEN CULTIVATION

By garden cultivation is meant the intensive cultivation of a very small area of land usually irrigated from a well or from channels run off from streams. On these garden lands only crops requiring great care and heavy manuring are grown, such as pepper, betel or areca palm, cardamoms, ginger, vegetables, fruits, tobacco, and sugar cane. The owners of the garden lands are usually the richest cultivators of their district, having their own house standing in the midst of its fertile garden instead of the usual house in the village group many

FIGURE 38.—One of the pepper gardens for which the Malabar coast of South India is famous. The forming of a spice garden is a long and extensive undertaking, but once started the profits are large. Hence it is usually the richer peasant who owns a spice garden and in the Kanara gardens the owners are cultivating castes who have had them for centuries. For the crops grown in the spice gardens, see the previous diagram. (Courtesy of Indian Trade Commissioner.)

miles from the fields. No better example of this garden cultivation can be found than the famous spice gardens near Sirsi in Kanara. They are typical of the "garden cultivation" of this southwestern area of the peninsula in Malabar, the Kanaras, Cochin, and Travancore, which is one of the richest areas in all India for vegetation. These gardens are situated on the lower slopes of the Western Ghats where in the fertile valleys, watered by the streams which are used to irrigate the gardens, the land is cleared of its virgin forest. The rainfall is plentiful, and irrigation is carried on by wells or by stream channels. The soil is a rich mixed red or grey loam, and the cultivators are allowed certain areas of the forest (nine acres of forest to each acre of garden) for the collection of leaf manure. These gardens have been in the hands of cultivating castes for centuries, and the standard of cultivation is very high. Many are Brahmins, and the cultivation is said to be over 1,000 years old in some of the gardens. There are few labourers since the owners do most of the cultivation themselves.

The chief crops of these gardens in Kanara are betel, cardamoms, and pepper. On the more level lands of the valley the crops of rice and sugar cane are grown as food for the cultivator, while on the poorer soils above the gardens hardy "dry" crops of millet are grown. Another crop grown in these gardens is plantain. This affords shade, which is very necessary in this form of cultivation. The careful cultivation and irrigation in the gardens is apparent in Figure 37. The plantains are usually set first in June or September. Then

when these are high enough to shade the garden the betel seedlings are put in. When the betel palms are about ten years old, the pepper vines are trained on them, and the cardamom seedlings are put in, one between two palms, as will be seen from the diagram. Then the plantains are usually removed. "The making of a garden is thus a long, laborious and expensive business, and whether it pays largely depends on the length of time that, once established, it will last." Betel in these gardens lasts at least fifty years, and as new trees are put in continually the garden can be kept permanent. The same applies to pepper. Cardamoms last anywhere from seven to twenty years. Betel bears fully at about ten years, pepper at six or seven, and cardamoms at about three years. It is noticeable that the harvesting season extends over some time in these gardens since the pepper berries are ready for picking about March, the cardamoms from September to November, and the betel nuts from November to January. There is practically no "slack" season in this form of cultivation, for constant care is required while the plants are at these different stages of fruiting or flowering. These gardens are profitable, for they were estimated to yield a profit of Rs 260, which, compared with Rs 32 profit on groundnut, is considered high.

All garden lands do not show such intense cultivation as those cited above. The usual garden land, outside this southwestern area, is a small patch irrigated from a well where such crops as tobacco, onions, indigo, ginger, or vegetables can be grown, which find a ready market in the big cities like Bombay, Madras, and Madura. Hence it is that nearly

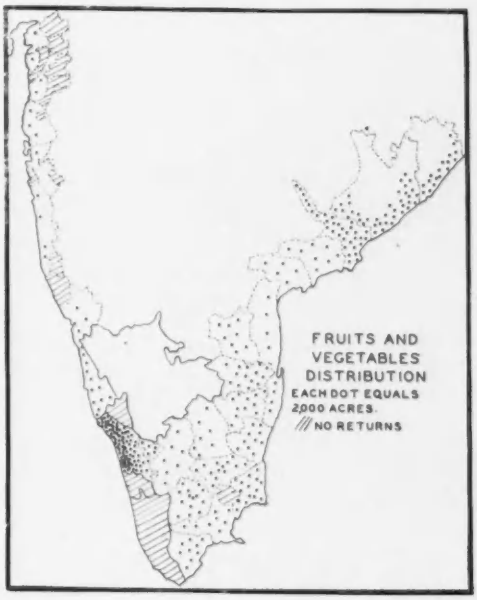


FIGURE 39.—These include fruits like mango, plantain, citrus fruits, grapes and figs, and vegetables like sweet potatoes, ginger, onions, and many of our common vegetables as cabbage, cauliflower, and beets which find a good market in the big cities like Bombay. Mango is the fruit *par excellence* of India, and is planted round the villages and on waste land. The large fruit acreages in Malabar and northeastern Madras are due to the extensive growth of the mango.

every district can boast of some garden land. This land is usually intermediate between the rich bottom rice land and the more sloping hill lands. Particularly is this true along the west coast of the Bombay Presidency where the land, as before cited, is classed into rice land, garden land, and "varkas land" or upland on which millets and pulses are the chief crops. The distribution of condiments and spices such as pepper, betel nut and chillies, and of fruits and vegetables, are shown on Figures 36 and 39 as typical garden crops. Although well distributed, the salient fact about them is their small acreage which is compensated for by their intensive cultivation.

Before concluding this survey of

food crops, mention must be made of the many oilseeds such as groundnut, sesamum, castor seed, and coconut which are grown throughout Southern India. They will be treated in detail under the heading of "Commercial Crops," for they are one of the chief exports of the region, but they are mentioned here because they are also widely used for food and domestic purposes by the native.

A SOUTHERN WEST VIRGINIA MINING COMMUNITY

Raymond E. Murphy

IN SOUTHERN West Virginia, Tug Fork and its many tributaries have dissected the original surface of the Appalachian Plateau into an area of sharp divides which rise 800 to 1,000 feet above a well-developed stream system, markedly dendritic in pattern. Here thin and infertile soils, steep slopes, and consequent inaccessibility have long interfered with settlement and use of the land. It is on this virgin territory that the mining of bituminous coal has placed its imprint, and the landscape of this section today owes its cultural aspects almost entirely to coal mining. The valley of Elkhorn Creek, a tributary of Tug Fork, accounts for 40 per cent of the coal production of the famous Pocahontas Field and exhibits within a limited area the complex of cultural and natural forms which one comes to associate with this general region. Elkhorn Valley has, for this reason, been chosen for detailed consideration.

By far the larger part of the area drained by Elkhorn Creek and its tributaries is comprised of upper slopes, divides, and high ravines which are covered with second growth forest (Fig. 1) and stand out in marked contrast to the unforested, busy, densely peopled, lower slopes and floors of the main valley and its principal tributaries, where coal mining is everywhere in evidence.

The Upper Slopes, Divides, and High Ravines

Non-utilization, or, at best, extreme meagerness of utilization, characterizes the higher lands. Sharp divides furnish almost no land suitable for even the poor farming typical of this part of West Virginia, and the steep, rocky slopes are useful only as forest land. The original mixed hardwood forest which covered this area has been logged off for mine timbers and lumber, and the young, second growth cover of oak, hickory, beech, and chestnut is still patchy, in places thin enough to show the scars of old log-snaking trails, while many of the ravines are choked with rhododendron and laurel in thickets so dense that they are almost impenetrable.

Contact of the Two Landscape Types

From one of the upland ravines flows Little Fork (Fig. 2), one of the two small streams which form the headwaters of Elkhorn Creek. At first the vegetation mantle of the little valley is interrupted only by a highway which angles its way down from the divide to the east. Then the sharp gradient of the youthful stream results in intersection of the famous Pocahontas No. 3 coal (Fig. 3), the most productive seam of southern West Virginia, a low volatile or "smokeless" coal with an average thickness of six and one-half feet. Only a short distance downstream from this point two mines occur, and thus is ushered in the complex landscape of the lower slopes and valley floors with its wealth of forms related to coal.

The line of demarcation between the two landscape types thus differentiated is by no means uniform in elevation. Conveyors extending to

drift mouths several hundred feet up the valley side form upward projecting spurs of valley floor landscape and occasional cultivated patches on the steep valley sides, cared for by miners in their spare time, form similar upward extensions from the valley floor. Between these spurs, downward projecting bulges of forest at places reach to the very edge of the narrow valley bottom.

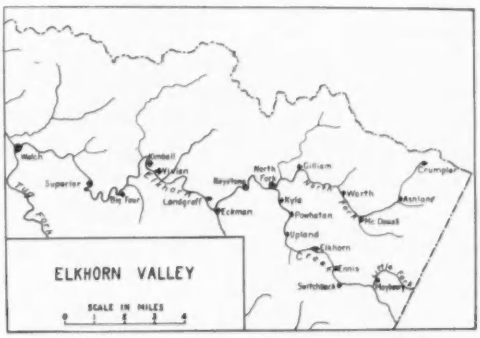


FIGURE 2.—Place map of Elkhorn Valley.

THE LOWER SLOPES AND VALLEY FLOORS

The two mines of Little Fork Valley, both belonging to the Pocahontas Fuel Company, are of the drift type common to the dissected plateau country, entered by horizontal tunnels driven into the coal seam where it outcrops on the valley sides (Fig. 4). Both the type of entry and the room and pillar system used in the mines are possible only by virtue of the rocks having but a slight dip, here amounting to less than two degrees.

The mouths of the mines and adjacent drifts used for ventilation are not prominent features of the landscape. Far more prominent is the tipple, a large wooden building connected with both mines by narrow gauge track. Occasionally, trains of mine cars, loaded with coal and pulled by small electric motors, come from the drift mouths to the tipple where they are dumped (Fig. 5). The tipple straddles several lines of standard gauge track, one for each commercial size of coal, and cars on

FIGURE 1.—Wooded divides and high ravines of the Elkhorn Valley country.

these tracks are being loaded preparatory to movement down valley to the main line of the Norfolk and Western Railroad. The presence of tipples throughout the length of Elkhorn Valley does not mean that all of the coal mined is screened and marketed as graded sizes, for nearly half is sold as "run-of-mine," part lump and part slack, just as it comes from the mines.[1]

FIGURE 4.—A drift mouth in the valley of North Fork of Elkhorn Creek.

From the mine mouths narrow gauge tracks lead out along the valley sides where the dumping of waste has formed striking black terraces along which the tracks are periodically extended as the dumps grow.

Downstream from the two mines, Little Fork Valley presents several mines is now black with fine coal and waste which, locally, has been deposited to form terraces and bars. The railroad track which began at the mines now shares the valley with the highway, and, to complete the crowding, houses begin to appear,

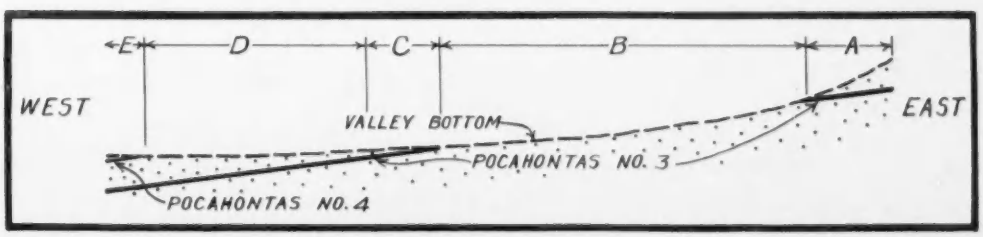


FIGURE 3.—Diagrammatic profile of Elkhorn Valley showing effect of valley gradient on method of mining. The vertical scale is exaggerated for diagrammatic purposes.

In zone A the coal is beneath the ground surface and could be reached only by a shaft, but this is not done since drifts can be extended in from zone B. In zone B the valley bottom is beneath the Pocahontas No. 3 coal seam, the coal seam outcrops on the valley sides, and drift mines are driven into the outcropping seam. In zone C a lessening of the stream gradient without change in the dip of the rocks causes the Pocahontas No. 3 coal seam to pass beneath the valley floor again as in A. Since it is only a short distance beneath the valley floor the coal seam can, in zone C, be reached by slope mines on the floor of the valley. In zone D the Pocahontas No. 3 coal is too deep for a slope mine and the more costly shaft mining must be resorted to. At the same time, as a result of the steady though gentle northwest dip of the rocks, the Pocahontas No. 4 seam, eroded away farther east, here outcrops on the valley sides and is mined by drifts. Finally, in zone E, Pocahontas No. 3 is too far beneath the valley floor to be profitably mined by any method at the present time; Pocahontas No. 4 has passed beneath the valley floor and may be reached by slopes or shafts; and still higher and younger coals outcrop on the valley sides and are mined by drifts.

new aspects, although it is still sharply V-shaped, with forested sides rising at an angle of 40 or 45 degrees to sharp divides 500 to 700 feet above. The little stream which marked the center of the valley even above the arranged in single file in accordance with the valley trend. A little farther along there is room for two rows of houses east of the stream, though the street between the rows must be shared with the Norfolk and Western track, while across the stream there is room for only an occasional house linked with the highway

[1] Rogers, H. O., and Tryon, F. G., "Fitting Product to Consumer's Needs," *Coal Age*, Volume 34, pp. 30–32, 1929.

FIGURE 5.—A tipple in Elkhorn Valley. Note the enclosed conveyor belt crossing the highway on the left, the cars of sized coal on the tracks ready for shipment, and, on the distant hill slopes, patches of land cultivated by the miners.

by an elevated pedestrian bridge. The creek's banks in many places have been reinforced with a rock facing to prevent possible encroachment upon valuable valley bottom land and to keep the course straight, allowing a more economical arrangement of the houses and competing cultural forms. This is the village of Maybeury.

Maybeury is a typical coal mining village, built by the Pocahontas Fuel Company for its miners and consisting of rows of frame houses, monotonously similar in details of construction, and each enclosed by an open board fence (Fig. 6). Just within the fence are double red brick coal bins, one for each two houses, which the company keeps filled at a fixed rate per month. A row of poplars follows the fence on each side of the street, these rapidly growing trees being a natural choice for a short-lived village. Water is supplied by hydrants placed at regular intervals along the street and comes from a tank high up the valley side which is filled by pumping from a drilled well on the valley floor. Although the houses have no plumbing they are, as a rule, moderately comfortable and clean, the latter condition insisted upon by the coal company. Part of the sewage is disposed of by means of the stream which is rapid and of fair size.

The true center of Maybeury, like that of other company villages, is not the post office but the company commissary, a frame building of much the same material and construction as the houses, but much larger. It is the social and business center of the community. Here the men are paid and here is the company store where most of the trading is done, while the porch affords a gathering place for miners after working hours or during temporary "layoffs."

In the mines near Maybeury, as well as elsewhere in Elkhorn Valley, white and colored men work side by side and both races live in the village. Though the colored families are segregated and though their children go to separate schools, their houses and

FIGURE 6.—A portion of the village of Maybeury with railway trestle in the background, and, still farther in the background, typical wooded upper slopes.

school buildings are as good as those of the white people. The valley is entirely non-union, a condition common to this section of the Appalachian Coal Field.

Just downstream from the portion of Maybeury here described, Little Fork enters Elkhorn Creek. Although the latter is the main stream of Elkhorn Valley it is, before the junction of the two streams, about

FIGURE 7.—Beehive coke ovens near Superior, Elkhorn Valley. Though not now in use these ovens were used only a few years ago and are still in good condition. In the center of the picture is a shaft mine with combined head-frame and tipple above which hoisting wheels can be seen. Shafts are used where the coal seam is too deep for a slope mine.

the same size as Little Fork, and their valleys present much the same appearance. Down the upper Elkhorn Valley, after tunneling the divide to the east, comes the main line of the Norfolk and Western Railroad which connects the Atlantic Seaboard with the Middle West.

A row of decaying beehive coke ovens borders the railroad tracks along Elkhorn Creek just above the confluence of the two streams. Partly fallen in and overgrown with grass, these and similar ovens at many places down valley recall a time when the making of coke was common. However, the industry was never as important as the number of old coke ovens would suggest, for at one time the railroad company allotted cars to coal producers on the basis of number of coke ovens, and this stimulus resulted in the building of many ovens which were never fired. The coal produced locally is excellent for coking, said to be as good as, or better than, the famous Pittsburgh coal in use in the Connellsville district of Pennsylvania, and a considerable amount is eventually made into coke. However, because of the country-wide shift to the by-product process and the lack of local industries to use by-products, for some years it has been found unprofitable to make coke locally.

Almost every village of Elkhorn Valley has its old coke ovens. Some were used only a few years ago and are still in good repair (Fig. 7), while others have almost completely disintegrated. In several places houses occupy terraces of old coke ovens, and the tenant of one of these dwellings makes use of the ovens to house his chickens (Fig. 8). In still another place the bricks of old ovens have been broken up and used as road material.

Below the junction of Little Fork and Elkhorn Creek there is a series of settlements much like Maybeury in appearance. Each is very much elongated in response to restrictions of valley shape, and it is partly because of this "shoestring" character that they are essentially continuous.

FIGURE 8.—Houses occupying a terrace of old coke ovens, two of which are fenced in to form a chicken coop.

Distinct village names are given to spots of slightly greater population density, but company commissaries (Fig. 9) invariably mark the true centers of the communities. Each village consists of uniform wooden houses, details of construction and color differing with the various coal companies.

At Switchback, as a result of the continued steep gradient of Elkhorn Valley, the coal seam outcrops high

up on the valley side and the operating company has located its mines some distance up a small tributary. In this way it is possible to bring the coal down the relatively easy slope of the tributary valley floor instead of using the precipitous wall of the main valley. Where no tributary is available and the coal seam is high up the valley side, either steeply inclined tracks lead from the drift mouth to the tipple or a long conveyor belt is used.

FIGURE 9.—A typical mining camp of Elkhorn Valley. Note the stream junction location and the presence of the commissary, the largest building in the picture.

At several points on the valley sides old waste dumps and the road beds of inclined tracks, the rails and ties removed, mark mines long since abandoned. A second growth forest is gradually obliterating all evidences of these obsolete landscape forms.

Here and there little streams course down the valley sides, their lack of distinct valleys marking them as artificial in character. Almost constant pumping is necessary in most of the mines, and these streams carry away the water thus furnished. Abundance of ground water, though it entails expensive pumping operations, is of advantage to a few small mining camps which pipe a water supply from hillside springs.

Piles of mine timbers border the railroad in a few places, timbers which have been hauled in from outside the valley, partly underground from an adjacent valley. Much mine timber was formerly obtained locally as the log-snaking scars on the hillsides suggest, but this supply is now largely exhausted.

Although almost all of Elkhorn Valley is leased by one or another of the mining companies, it is their custom to allow employees to cultivate the unutilized slope land. Consequently, the smooth, even spread of forest is broken here and there by small cultivated patches, where a little corn, and a few potatoes and beans are raised by the miner and his family. Most of the scattered, iso-

lated fields, dotted with dead trees and stumps, are ridiculously steep, slopes of 35 and 40 degrees being common. Plowing follows the contours, but for many of these cultivated plots the hoe is more suitable than the plow.

Various devices are used to prevent excessive slope wash. Loose rocks are abundant, and in some cases the stones which have been gathered from the fields have been built into low walls to support relatively flat terraces. Brush serves the same purpose, and both brush and rock dams are used to check excessive erosion in the gullies.

This casual tillage by people engaged primarily in mining is about the extent of cultivation in Elkhorn Valley, while livestock industries are represented chiefly by a few belled cattle of nondescript breed which wander aimlessly through the villages, seeking pasturage in a region where the bottom lands are more black than green.

To avoid the crowded valley floor, the highway, for considerable distances, keeps well up on the valley side on a ledge or rock terrace which has been artificially cut. In several places the Pocahontas No. 3 coal seam is visible as a thick dark band in the steep rock face which borders the inner edge of the terrace.

Near Upland, railroad tracks, coke ovens, stream, highway, and houses so crowd the valley floor as to necessitate the use of the lower steep valley sides for additional house sites, and terraces have been cut at several different levels, each with its row of houses (Fig. 10). In another locality houses have been adjusted to a steep slope by the use of tall posts underneath the front of each building.

FIGURE 10.—The crowded valley floor near Upland showing, in the background, the use of artificial terraces for house sites. Note, also, the water tank on the hillside, the coke ovens, the stream, and the tipple, the latter connected by conveyor to a drift high up on the valley side.

Just below the village of Kyle, Elkhorn Creek is joined by North Fork, a tributary almost as large as the main stream itself, with a valley which is nearly an exact replica of the upper Elkhorn Valley just described.

FIGURE 11.—A slope mine. Here the coal seam is some distance beneath the valley floor and yet not deep enough to require a shaft. Hence an inclined tunnel or "slope" is used to reach the seam.

As in the more southerly valley, a stream, a railroad, and a highway compete with houses for space, the congestion being explained by a series of drift mines with their attached tipples.

At the junction of the two streams lies the city of North Fork. With its red brick business buildings and private houses of varied architecture it is quite evidently not a mining camp. The ratio of business houses to homes is high, in marked contrast to conditions in the company camps, each with its single business building, the commissary. Location at the junction of two valleys gives the city a large trade with the mining villages of each, and with those just down the main valley as well, the people of these settlements being attracted by lower prices than the commissaries afford.

West of North Fork, Elkhorn Valley still presents a succession of mining camps interspersed with which there are a few "independent" villages. Elkhorn Creek is somewhat larger than it was before the influx of the tributary, but its valley is still V-shaped and much the same congestion prevails on its floor and lower slopes. To avoid the windings of the valley in this section the railroad tunnels several spurs and has cuts through some of the lesser ones. The importance of the railroad is obvious from the way in which it broadens out in favorable spots to many parallel tracks upon which rows of cars of coal await shipment. This importance is suggested, too, by the Norfolk and Western Railroad shops at Eckman and Kimball, two villages a little down valley from North Fork. Both electric trains and trains drawn by steam locomotives operate on the valley tracks.

The electricity used by the Norfolk and Western Railroad and most of that used by the mining companies of the valley is purchased from the Appalachian Electric Power Company. A few of the mining companies make their own power, but purchase from the power company is considered more economical and is a much more common practice. The power company's substations and lines are striking features of the valley landscape and part of the surface expression of the mineral resource, coal, since without this there would be little demand for power. Wide paths are cleared for the lines which

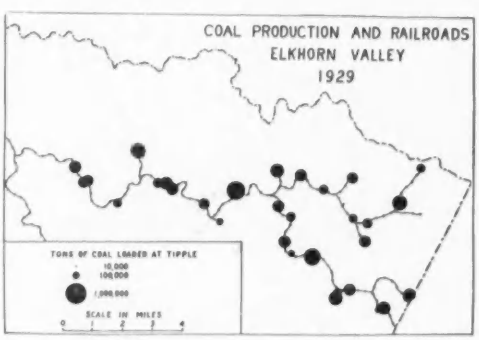


FIGURE 12.—Coal production and railroad distribution of Elkhorn Valley. The total coal loaded at tipples in Elkhorn Valley in 1929 was about 9,000,000 tons. (Based on Annual Report of the West Virginia Department of Mines for 1929 and upon field observation. The railroads are those shown on recent topographic sheets.)

pursue a straight course across hills and valleys alike.

With a decrease in valley gradient below North Fork there is no corresponding decrease in the gentle though steady northwest dip of the rocks. In fact, the dip becomes slightly greater. Hence, the Pocahontas No. 3 coal occupies successively lower positions on the valley wall until, about eight miles west of North Fork, it passes beneath the floor of the valley (Fig. 3). At Big Four, a little beyond the place where the seam disappears, the coal is reached at a depth of 50 feet by a slope, that is, by an inclined tunnel (Fig. 11). Two miles farther on, at Superior, it is mined by a shaft (Fig. 7), recognizable by the sheaves or hoisting wheels which project above a combined head-frame and tipple. As the Pocahontas No. 3 coal reaches an increasing depth toward the west, it becomes too deep for shaft mining under present conditions, while other higher and younger coals outcrop on the valley sides and are mined by drifts.

At the point where Elkhorn Creek enters Tug Fork, Welch, a city of 5,000 people, has developed. Larger than any of the other settlements, it is like North Fork an "independent" city, showing the same large ratio of business houses to homes and the same prevalence of brick construction. It has, however, more wholesale establishments, since it serves not only Elkhorn Valley but the upper Tug Fork as well. Through Welch passes two-thirds of the coal from Elkhorn Valley (Fig. 12), destined for steam, domestic, and metallurgical uses in the Middle West and Lake states.[2] Most of the remainder of the coal goes east to Hampton Roads for coastwise shipment to New England. In addition to its commercial activities, Welch is a county seat, for which function it is admirably suited by its stream junction location.

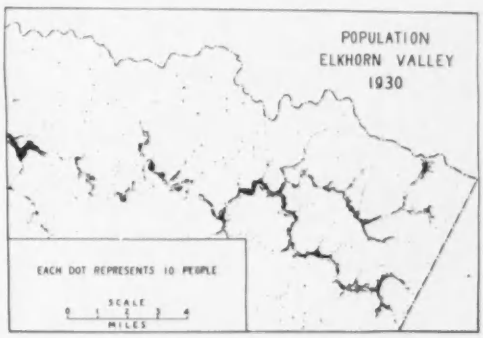


FIGURE 13.—Population distribution in Elkhorn Valley, 1930, showing strikingly dendritic pattern. (Based on United States Census figures for 1930, on the distribution as shown on topographic sheets, and on local supplementary data.)

RELATION OF SURFACE AND SUBSURFACE CULTURAL FORMS

An invisible but extremely significant part of the cultural landscape is the vast network of intersecting tunnels, where the actual business of mining is carried on. Though underlying the wooded hills and divides, this underground world bears little relation to these higher lands, but finds surface expression in the whole assemblage of cultural forms characteristic of the valley floors and lower slopes. Thus it is only where the coal has been eroded away that the surface forms due to coal mining are concentrated, and the cultural landscape has a pattern which is dendritic (Fig. 13), like that of the streams which have dissected the plateau.

[2] Statements regarding distribution are based on Coal Distribution reports of the United States Bureau of Mines.

THE OAHU SUGAR CANE PLANTATION, WAIPAHU[1]

John Wesley Coulter

TWO factors handicap the sugar cane industry in the Hawaiian Islands. The peculiar isolation of the islands, with the resulting scarcity of labor, works a hardship on all the plantations of the territory. The climate, with its cool winters and its scant annual rainfall in large areas, delays growth and necessitates costly irrigation for a large number of the plantation companies. In 1928 the sugar produced on irrigated plantations amounted to 596,550.46 tons as compared with 300,845.74 tons produced on unirrigated plantations.

Oahu plantation, at Waipahu, with its $5,750,000 irrigation plant and its unique labor organization, provides a concrete example of the methods devised by human ingenuity to overcome these two obstacles. The management of this 12,260 acre plantation which produces 8 per cent of the sugar produced in Hawaii, has adopted methods worthy of study by the student of economic geography.

Oahu sugar cane plantation is located on the leeward side of the island of Oahu, about fifteen miles from the city of Honolulu. Of its 12,260.33 acres, 11,530.68 acres are used for raising sugar cane. The remainder provides sites for mill, pumps, "camps," and includes some pasture and waste land.

The plantation is owned by the Oahu Sugar Company, Ltd., incorporated in 1897 under the laws of the Hawaiian Islands along lines similar to other business corporations. Previous to that year the land now devoted to the production of sugar cane was used for rearing cattle. About ninety-four per cent of the land is leased land, and the remainder is held in fee simple.

Layout of the Plantation

The scale of operations on this huge farm can be visualized by a picture of the layout of the plantation.

The most conspicuous feature in the landscape is the mill. Its two tall smokestacks rise high above the large galvanized iron building, heavily coated with paint to preserve it from the corrosive results of exposure to a tropical climate. From inside the mill extends a narrow gauge railway track paralleled outside by ten sidings.

Near the mill is a chemical laboratory, a one-story building, the diminutive size of which is in contrast to the tall structure towering above it.

In the vicinity of the mill are sheds for agricultural implements and tools, for plow-engines, for all the various kinds of machinery used in a large-scale agricultural enterprise. Several plow-engines and tractors stand in the open air in spaces reserved for them.

The headquarters building, the hub of the plantation, is also situated

[1] This article is based on field work carried on at irregular intervals during 1928 and 1929. The author wishes to acknowledge courtesies received during the course of the study from Mr. Ernest W. Green, manager of Waipahu Plantation. All photographs were taken on the plantation and with one exception were furnished by the Williams Studio in Honolulu.

near the mill. Set apart in a small plot of ground and shaded by tall trees, it has an atmosphere of dignity and an exclusiveness which mark an important center for the conduct of affairs of a large corporation.

A short distance from headquarters is a group of one-story frame buildings, with "lanais" or covered porches, neatly painted, and set at the back of shaven lawns separated by trim hedgerows. These are the homes of the plantation executives,—the Caucasian, or "haole," employees of the company.

Nearby, other one-story frame buildings, ranged at short intervals along both sides of well-kept streets house laborers of other racial extractions. Their general appearance, objects in their immediate vicinity, or both, generally betoken the racial origin of their occupants. Flowers or greenery in gaily tinted pots adorn the window sills and lanais of Jap anesehomes. A few fishing nets may often be seen on fences outside Hawaiian dwellings. Many Portuguese homes have small flower gardens in front. In the Filipino quarter of the "camp," or plantation settlement, the houses have fewer indications of the identity of their occupants than those of other nationalities. In this section are dormitories for single men and mess halls.

FIGURE 1.—The sugar cane mill, Oahu Plantation, Waipahu; part of the "camp" and fields of sugar cane. (Courtesy of U. S. Army Air Corps.)

The manager's home, the most pretentious dwelling on the plantation, is a two-story frame building situated on higher ground a short distance from the "camp." It is surrounded by shade trees, with a well-kept lawn and flower garden in front.

FIGURE 2.—Headquarters building, the hub of the plantation, is situated near the mill.

Near the "camp" is a business district similar to those which serve a rural community on the mainland. However, nearly all the stores are owned or operated by Japanese.

Three quarters of the 10,000 inhabitants of Waipahu earn a living in connection with the production of sugar by the Oahu Sugar Company. The remainder of the people earn a living because of other factors which have contributed to the growth of the town. Among these are the fact that it is on a spur line near a railroad junction of the Oahu Railway. It is also on the Government Road from Honolulu to the Waianae district and the Ewa Plantation. This makes it easily accessible as a business center for truck farmers and wet-land farmers in this section of the island.

About one-eighth of a mile from the town of Waipahu is a small suburban settlement near which are found stables for mules used on the plantation, and barns for provender.

Stretching away for miles northward, eastward, and westward, from the urban settlement of the plantation, sugar cane to the extent of thousands of acres in scores of fields undulates in the vigorous breezes of a trade wind climate. A field of full-grown cane resembles somewhat the appearance of a similar area of standing corn. Stalks, ten to fifteen feet high, from which hang long narrow leaves, grow near together in rows and form what looks like an impenetrable jungle when viewed from a short distance away.

Fields of tasseled stalks, ripe for harvest, are interspersed with fields of cane in various stages of growth. Here and there are areas of mottled brown which mark fields in which remain the stumps of harvested cane, and reddish brown patches indicative of soil recently plowed.

FIGURE 3.—Laborers' Homes on the Oahu Plantation.

FIGURE 4.—Mature H 109 cane. Since thousands of varieties of sugar cane are produced each year at the experiment station and substations of the Hawaii Sugar Planters' Association, they are identified by symbols, a more practical way than that of giving individual names.

Adjoining fields are separated by tracks of permanent railway, by irrigation ditches, dirt roads, or merely by furrows.

When viewed from a sufficiently high elevation the plantation scene also presents small groups of houses at outlying points within its confines. These are hamlets or villages where laborers live in proximity to the fields in which they work. The scattered settlements are generally situated at cross roads on a plantation or at the junction of two roads.

The cultural landscape also shows here and there solid, concrete buildings which house pumps. Near some of them are reservoirs.

AGRICULTURAL OPERATIONS

Agricultural operations on Oahu plantation are carried out on a scale commensurate with the area of the plantation and with the care and attention to detail necessary for the successful raising of sugar cane on the leeward sides of the Hawaiian Islands. While Cuban sugar planters and those of Java also can raise a crop of sugar in twelve months, Hawaiian planters must wait eighteen to twenty-four months for a crop to mature. Furthermore, the greater part of the rainfall in Cuba occurs during the months of higher temperatures, a time when the growth of sugar cane is more rapid than during the cooler months.

The average monthly temperature at Waipahu ranges from 69.7 degrees in January to 77.7 degrees in August.

The soil of the sugar cane land, like that of all the land in Hawaii, is derived from decomposed, basaltic lava, the product of very recent vulcanism. There are two varieties of this soil. One is residual soil formed by the weathering of lava under climatic conditions of great heat and dryness. It is dark red in color, light, and easily worked. Though clay-like when wet, it does not become compact on drying, and may be tilled under conditions of rainfall impossible with true clays. The other variety is sedimentary soil derived from the decomposition of lava at high altitudes, then trans-

FIGURE 5.—Plowing up the roots of a ratoon crop. The plow is moving towards the right of the picture, drawn by an engine similar to the one shown.

ported to lower levels by rainfall and deposited there. The sedimentary soil is considerably deeper than the residual soil. An exceptionally high porosity of both these varieties makes for rapid drainage, easy aëration, and also large root development in the sugar cane.

These unique conditions of the environment necessitate highly specialized varieties of cane.

The most important variety raised is H 109. Out of 6,101 acres of cane harvested in 1929, 5,390 acres were of this kind. In that year the sugar cane harvested from 657 acres was the variety D 1135. Fifty-four acres were planted with other varieties and miscellaneous seedlings.

The land is prepared for seeding by thorough plowing. Plows and other types of machinery for cultivating the soil are blunter, heavier implements than those used in the Middle Western States. On Waipahu, as elsewhere in Hawaii, soils do not become compact and are pushed and crumpled before a plowshare rather than turned over as in the Middle West. Thorough tillage is essential because of its effect on the soil especially in regard to its water-holding capacity, and because the land is planted with seed cane only once in eight to fourteen years. Five or six crops are raised from one sowing, subsequent crops being ratoon crops.

The seed consists of pieces of stalks about two feet long, usually cut from the tops of ripe cane before harvest. The pieces are placed about two feet apart in furrows plowed at intervals of five feet. About ten per cent of the area of the plantation is seeded each year.

By the end of a few weeks the seed has sprouted and reached a height of from one to two feet. At this time laborers hoe out the weeds and loosen the earth about the roots of the cane.

As the growth of the cane proceeds, fertilization of the soil is necessary to replenish elements used up by previous crops. The fertilizers commonly used are nitrate of soda, phosphoric acid, and potash. The amount of fertilizer used varies from two to three tons per acre, as determined by a careful analysis of the soils of various fields. This large amount of fertilizer is necessary because of the

FIGURE 6.—Fertilizing young cane. The amount of fertilizer used varies from two to three tons per acre, determined by carefully analyzing the soils of the various fields.

invariable practice of one crop continuous agriculture. The cost of fertilizing an acre of sugar cane varies from $60 to $75.

The husbandry of ratoon crops is carried out in ways somewhat similar to those for seed cane.

IRRIGATION

The absence of sufficient rainfall for sugar cane in sections of the Hawaiian Islands, such as Waipahu, necessitates a costly irrigation system. The rainfall varies considerably from year to year, with an annual average of about twenty-four inches; during each of the three hotter months the precipitation is less than one inch.

To make up the deficiency in moisture, the Oahu Sugar Company spent almost six million dollars to build an irrigation system, which requires an annual outlay of $365,000 for power for pumping alone. The capital invested in water works, the cost of maintenance of these, and the expense incurred in applying water to the fields makes a very large percentage of the total expense of the production of sugar.

The difficulty of securing water for irrigation is further complicated (1) because of the absence of large rivers on the island, (2) because of the absence of suitable dam sites for reservoirs on such streams as there are in the vicinity of the plantation, and (3) because of the porous nature of the soil which allows surface water to seep quickly to a ground water level which is a considerable distance below the surface.

The plantation is situated on the lower slopes of the Waianae mountains, a location where irrigation is more difficult than on level ground. The upper parts of the gulches of the mountain streams are narrow and steep and therefore poor sites for reservoirs, because the amount of water held by the construction of dams would be small. The lower parts of the gulches, while suitable

FIGURE 7.—Pumping Stations on the Oahu Plantation. Most of the water used for irrigation is pumped from wells, located, for the most part, in the gulches of intermittent streams.

for reservoirs in many places, are too near sea level to have a gravity flow of water to a sufficiently large area of the plantation to make dam projects profitable.

On Oahu plantation the largest portion of water used for irrigation is pumped from wells, located, for the most part, in the gulches of inter-

FIGURE 8.—Applying nitrate of soda in irrigation water.

mittent streams. Pumps are operated by electrical machinery with power generated at the mill, supplemented by power from the Hawaiian Electric Company, Honolulu.

During the dry season, ninety-four million gallons of water from wells are pumped daily to heights which average 375 feet above sea level. In addition, thirty-two million gallons a day are obtained from a mountain water ditch system penetrating by tunnels the Waianae and Koolau Mountains. Some of this water comes from the rainy, windward side of the mountains.

A thousand laborers are employed in connection with the irrigation system. The system commonly used is known as the Hawaiian Furrow System, by which water flows to the field through a concrete canal, and is distributed through laterals, smaller channels, and furrows.

HARVESTING SUGAR CANE

The time of harvesting is selected as an economic balance between the peculiar environmental factors and the distribution of labor.

Harvesting begins in December and ends the following July. During the cooler months of this period the laborers can work to best advantage. The optimum ripening period is from the later part of February until the end of April. However, if all the cane to be harvested were cut during this period, a temporary reënforcement of the labor staff would be necessary. And one of the important objectives of the plantation management is to give employment throughout the year to a permanent labor force.

Each crop harvested is taken from approximately half of the available sugar cane land on the plantation. This is accomplished by harvesting early in the season the cane from certain areas from which a new crop will be harvested at the end of the following harvesting season, that is getting two crops from the same field in three years. It is more profitable to take the cane from these areas as "short crops" than to allow them to grow the customary maturing period on this plantation of twenty to twenty-four months.

FIGURE 9.—Burning cane before harvesting. This is done in order to make the operation of cane cutting less arduous.

A field of sugar cane ripe for harvest presents an appearance characteristically different from that of neighboring fields where the cane is in various stages of growth. The tops

of ripe cane are light yellow in color, and from them hang tassels in which is contained the flower-produced seed. Near the top of the tall stalks project leaves which are green, but about the middle and base of the stalks, the leaves, having ceased to grow, are dry and spicular. Both stalks and leaves present a tangle of vegetation

FIGURE 10.—Cutting sugar cane on the Oahu Plantation.

through which it is extremely difficult to pass.

In order to make the operation of cane cutting less arduous, cane fields are "burned" before the laborers begin operations.

Because of the large amount of juice in the cane, the stalks do not burn, but the dry leaves are totally consumed. This operation eliminates much leaf material which is not only useless, but which if carried to the mill and ground with the stalks, would increase the amount of waste material and absorb some of the juice expressed from the stalk.

As the burning destroys the eyes or buds, certain fields or parts of them are cut and topped for seed before the burning takes place. In some instances green leaves are also cut at this time for fodder for mules.

The morning after a sugar cane field has been burned, a gang of laborers attacks the charred stalks now made more accessible by the elimination of most of the leaves. The cane in the part of a field nearest the permanent railway is first cut. A cane cutter grasps a stalk in his left hand about three feet from the base and generally at one chop with the cane knife in his right hand, he severs it close to the ground. He then cuts off the upper part which does not contain sugar and, to aid in subsequent handling, cuts the stalks into lengths of about four or five feet.

When the sugar cane has been cut in an area of the field sufficiently large for further harvesting operations, the next step in the process, transportation of the cut cane to the mill, begins. Temporary railway tracks are laid in the fields of cut cane, over which cars are hauled to the permanent railways running to the mill.

FIGURE 11.—General view of harvesting operations, showing portable railway track, bundles of cane ready for loading, loading machine, and loaded cars.

The cars are loaded by a mechanical loader. The laborers gather the cut cane into piles, the dimensions of which correspond to the dimensions of the railway cars; the piles are picked up one at a time by a loader and dumped into the empty cars.

The yield of cane is from 80 to 110

tons an acre. It varies in different parts of the plantation, largely because of variations in soil but also due to exposure and to the care and skill exercised in connection with its husbandry. On the alluvial soil the yield is higher than on residual soil. Plant cane gives a higher return than a ratoon crop. In 1928 the average yield for irrigated plantations in the Hawaiian Islands was 8.10 tons of sugar per acre of sugar cane, that for unirrigated plantations was 5.25 tons of sugar per acre.

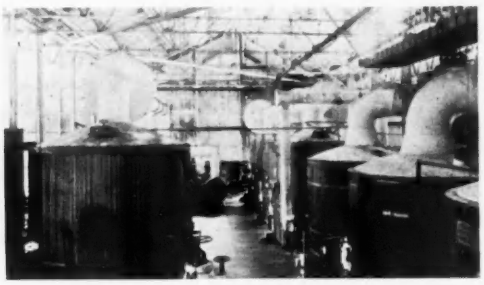


FIGURE 12.—Evaporators in the sugar factory on the Oahu Plantation.

EXTRACTION OF SUGAR

The arrival of the sugar cane at the mill marks the end of the operation of harvesting. There remains to be carried out the further process of extracting the sugar. This process is divided into six steps, namely, (1) crushing the cane and extracting the juice, (2) clarifying the mixed juice, (3) condensing the clarified juice into a thick syrup, (4) crystallizing the syrup, (5) separating the crystals from the mass, and (6) bagging for market.

The total output of Waipahu plantation in 1928 was 76,313 tons, about eight per cent of the sugar produced on the Hawaiian Islands.

LABOR

A problem of recruiting labor for sugar cane plantations is peculiar to the Hawaiian Islands. Java and Madura have a population of 37,433,760 (1927) from which to obtain a labor supply for the sugar cane industry. In 1928 the production of sugar in the Dutch East Indies was 2,937,376 tons, nearly all of which was produced in Java. The population of the Hawaiian Islands is 357,649 (1929 estimate). Honolulu, the port of arrival for the islands is approximately 2,091 miles from San Francisco, 4,330 miles from Shanghai, 3,394 miles from Yokohama, and 4,767 miles from Manila in the Philippine Islands.

An opportunity has been given to Filipinos to emigrate to the Hawaiian Islands with a promise from the Hawaiian Sugar Planters Association that they would receive employment in the sugar cane fields when they arrived. When they arrive, they are assisted in finding work on plantations by an executive of the Association.

There are 1,700 Filipinos employed on Waipahu Plantation, and 900 Japanese. There are in addition several hundred American citizens, many of them of Japanese, Portuguese, Chinese, and other racial descents, and also a number of Hawaiians.

The nature of the work on the plantation is such and the necessity for efficiency so great that systems of employment of labor are practised which (1) put as much responsibility as possible on the laborer, (2) pay him wages in proportion to his work, and (3) increase his contribution to the success of the business venture. The two methods of employment commonly practised are called "long term contract" and "short term contract."

Since the demand for labor is greatest during the harvesting season and since harvesting operations are carried on for only about six or seven months of the year, there remains an "off season" during which the labor force on a plantation must also be employed, as all labor is employed on a yearly basis.

The maintenance of equipment provides many laborers with employment for the off season. During this period the machinery of the mill is entirely overhauled. Plows, tractors, and other machinery must also be inspected and repaired. Most of the work in connection with the maintenance and repair of roads is done during the off season. The maintenance and repair of permanent railways also provide employment for a considerable number of men. There is the tearing down or repair of old sheds and the building of new ones. There are laborers' homes to be repaired and new ones to be built. All "odd jobs" which can be saved for the off season are postponed until then.

Laborers have perquisites in the form of shelter, fuel, and water. For married laborers the shelter takes the form of homes built, furnished, and kept in repair by the plantation company. Dormitories are provided for unmarried workers. Laborers also receive fuel. The plantation supports a hospital, with resident physicians and nurses, which provide medical service for the workers and their families.

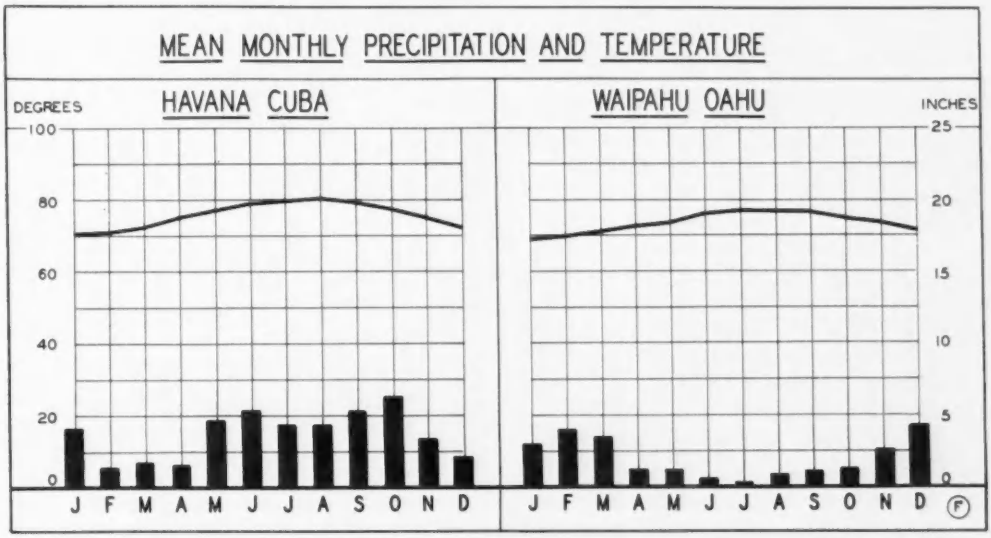


FIGURE 13.—Mean monthly precipitation and temperature at Havana, Cuba, and Waipahu, Oahu.

ORGANIZATION OF THE WORKING FORCE

A highly developed organization of the man power of the plantation, in an effort to get the largest return possible under existing conditions, again portrays the disadvantageous circumstances under which operations are carried on.

The manager is accountable to the company for the business success or failure of the organization, answerable for the morale of his workers, and directly responsible for the general welfare of the thousands of

people who live in the plantation "camp."

The close pressure of economic conditions makes it necessary that the junior officers on a plantation think and plan as well as the manager. Even field "lunas" or foremen, are required to make reports and to use their judgment and experience in the best interests of the plantation and the laborers under their immediate supervision.

The heads of all departments form a cabinet on whose judgment and opinions the plantation manager can rely. Each is an executive in his own restricted sphere and each has an opportunity to advance to a higher position in accordance with his education, experience, and ability. The promotion of one petty executive makes way for the ranking man beneath him.

COMMUNITY LIFE ON A PLANTATION

Although the business of raising sugar cane demands a worker's best and most intelligent efforts during the working day, and notwithstanding the fact that the work of a field laborer is arduous, the employees of the plantation have time and opportunity for recreation and social activities.

The Caucasian or "haole" employees have literary clubs and societies with headquarters in their club house furnished and maintained by

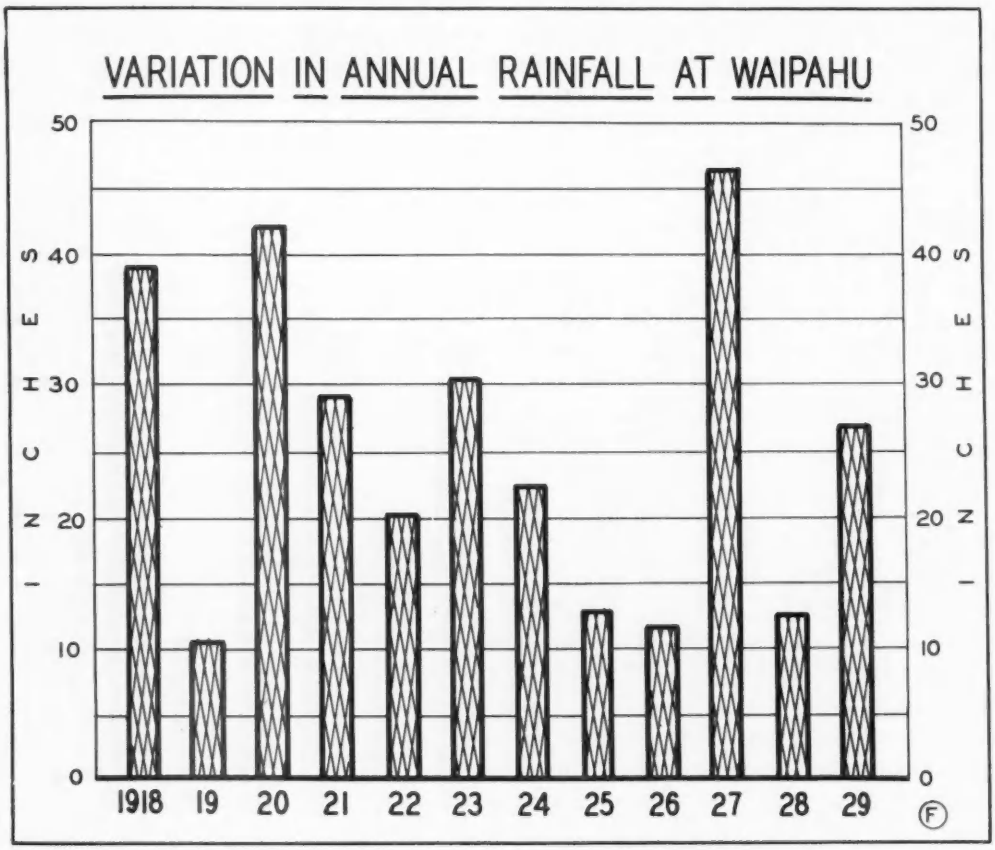


FIGURE 14.—Variation in the annual rainfall at Waipahu.

the plantation funds. The Filipino and Japanese workers have similar club houses. At Waipahu eight or nine baseball teams are organized to compete in intramural competitions. Trophies for tennis champions draw forth the best efforts of devotees of this form of sport.

In primary and secondary schools on the plantations the children have opportunities to complete the standard school course. In addition, two Japanese language schools are supported by the parents of the children in attendance.

A company of the Hawaii National Guard provides the drill and discipline which membership in such a unit entails and inculcates something of the spirit of American citizenship and the duties and responsibilities which it involves. This unit of the National Guard is composed almost entirely of young men of oriental extraction.

CONTRIBUTION OF OAHU PLANTATION TO THE SUGAR CANE INDUSTRY

The peculiar conditions of the natural environment of Waipahu, in common with that of irrigated plantations in Hawaii in general, have stimulated research and inventive genius to a high degree.

The research work carried on in coöperation with the Hawaii Sugar Planters' Association has mainly to do with the discovery and propagation of new varieties of sugar cane which would produce a high yield of sugar. Research work is also carried on along lines of combating diseases of sugar cane and pests. Problems in connection with field operations and grinding the cane have been solved for the benefit of the sugar cane industry in general.

The "Messchaert Groove," invented by P. A. Messchaert, formerly mill superintendent of the Oahu Sugar Company, at Waipahu, is used throughout the world on sugar mill rollers.

The Oahu Sugar Company plantation, with other similar Hawaiian agricultural units, has contributed to the progress of the sugar industry not only along research lines, but along lines of general organization as well. To overcome disadvantages of environment, particular methods of irrigation, fertilization, harvesting, and labor organization were adopted.

Thus has an environment unpropitious for the economical production of sugar stimulated man to exert his utmost ability to cope with natural conditions.

KILGORE, TEXAS: AN OIL BOOM TOWN

William T. Chambers

ASTRIDE the eastern boundary of the great "East Texas oil field" is Kilgore, a thriving boom city which evolved in response to recent development of the petroleum industry there. Under the abounding stimulation of gusher oil field exploitation, the place grew from an agricultural village into an aspiring city of several thousand inhabitants within a few weeks. Public improvements secured during the first year include a city government, city hall and jail, street lights, water and sewer mains, a police force, a fire department, many new streets, a block of paving in the business district, and several new public schools. There is an active chamber of commerce, a retail merchants' association, an energetic Lions club, a progressive daily newspaper, an American Legion post, a charity association, a high school football team, and other characteristic urban organizations.

Rows of attractive new business structures house a variety of retail stores, shops, and cafés; and there are hotels, garages, printing shops, and many professional businesses. An aggregation of oil field supply houses, lumber yards, and machine shops is located along the railway track. Residential sections are grouped about the central business district, and extend outward to the margins of the city. In general they are poorly developed, being occupied by "oil field shacks," tents, and improvised dwellings of various sorts. Some attractive new homes and the frame cottages of the former village stand majestically among these tiny residences, and along main traffic routes there are cafés, grocery stores, meat markets, automobile service stations, and other small businesses. Such residential development extends outward to agricultural land on the eastern border of the city, while on the west it is interspersed with derricks, torches, separators, storage tanks, and miscellaneous oil field phenomena. The separator of the oil field is a cylindrical tank so constructed that it separates the natural gas and the petroleum as they flow from the oil well. Ordinarily it discharges the natural gas into a torch or "flare" and directs the petroleum into a pipe line.

Location

Kilgore's location makes it a center of outstanding importance in the East Texas oil field. It is about midway between the northern and southern ends of the long strip of producing territory, and is nearer the central section of the field than any competing center. The highway to Gladewater and several roads connect Kilgore with the oil field. Also there are highways to Longview and Henderson, the two leading centers near the eastern edge of the field. Position on the International Great Northern railway facilitates the shipment of petroleum and receipt of supplies, and so favors the growth of business at Kilgore. Then it happened that petroleum was discovered at Kilgore sooner than at any other established town in the field, so that

the boom began earlier here than at most other places. Moreover Kilgore's location on the margin of the field is advantageous because it protects the eastern part of the city from invasion by oil wells so that here substantial residential development may occur.

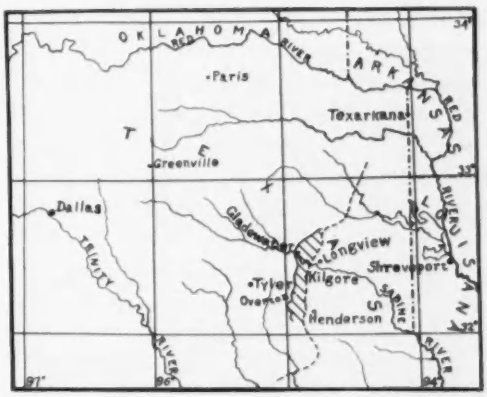


FIGURE 1.—The location and approximate extent of the East Texas oil field. Notice the position of Kilgore with respect to the producing area. The broken line indicates the approximate position of the eastern edge of the Woodbine sand. The petroleum is trapped in the margin of this formation between the "Tyler trough" on the west and the "Sabine uplift" on the east. The outline of the oil field and position of the eastern edge of the Woodbine sand are adopted from Plate I, Bulletin 3138 of the (Texas) Bureau of Economic Geology.

THE FORMER VILLAGE

In the autumn of 1930 Kilgore was a rural business center in a cotton farming district. There were a few hundred inhabitants; and the town had a railroad station, a post office, a bank, three cotton gins, and a row of retail stores facing Front Street and the railroad track. The residential sections consisted of rows of cottage homes along quiet shady streets.

The economic outlook of the community was discouraging. Farmers were dumping their cotton crop, the only important commercial product of the area, upon a severely depressed market at about ten cents a pound. This price was said to be well below the cost of production, so that farmers found it difficult to secure enough cash to pay their debts at the bank and stores. Accordingly merchants were making relatively few cash sales, and the risk involved deterred the extension of credit particularly to negro tenant farmers. Hence business was greatly curtailed, and the entire community was in the throes of an economic depression.

THE BOOM

This situation changed abruptly and completely on the last Sunday of the year (December 28, 1930). On that day the Bateman-Crim "wildcat" test for petroleum "blew in" as a gusher with an estimated daily capacity of 22,000 barrels. This great discovery precipitated a violent oil boom, an orgy of speculation in leases and royalty rights, and frenzied drilling activity. Kilgore was at once overrun by a multitude of strangers. The volume of local business soared to undreamed proportions; and, as the completion of new wells extended the proven productive territory, scores of new firms secured locations and opened their doors for business.

News of the discovery spread like wildfire. The next morning (Monday, December 29) found Kilgore "packed" with people and automobiles. They had gathered from surrounding towns and country and from oil fields within a radius of one or two hundred miles. A meeting of (leading) citizens was called for nine o'clock at the bank. Men who had just arrived as well as the local landowners were present. Several fiery speeches were made. The general sentiment ran— "We have found oil! Let's build a town!" The popula-

tion was imbued with a sudden prospect of wealth. Already the quiet conservative spirit of the agricultural village was gone. It had been swept away by the magic lure of oil, and the great business opportunities its exploitation afforded.

Kilgore was overrun by strangers. They crowded the business section,

FIGURE 2.—Front Street, the old business section at Kilgore as it appeared during the boom.

and their automobiles and trucks congested the streets so that through-travelers made wide detours to avoid the place. When freight trains blocked the railway crossing, traffic jams quickly formed extending a mile or more from the tracks. Most of the vehicles bore Texas, Oklahoma, Arkansas, and Louisiana license plates; but there were many from other states, particularly those having important oil fields. Highways of the section were infested with hitch-hikers bound for the oil field. Men slept upon court-house floors and in railway stations while making the journey, and frequently three or four dozen men alighted at Kilgore from a single freight train. A better type of newcomer arrived on passenger trains, and there were a few who came by private car or by airplane. Most of these people soon departed in the manner they came; but thousands secured employment, opened businesses, or entered professional life in Kilgore and other parts of the oil field area.

Most of the population influx came from other petroleum fields because such people were more conversant with the opportunities presented by the new field and more skillful in its utilization. The "oil fraternity" was abundantly represented by oil operators, oil scouts, oil well promoters, drillers, "lease hounds," royalty buyers, "brokers," geologists, engineers, and laborers. There were surveyors, abstractors, contractors, lawyers, clerks, tradesmen, mechanics, and stenographers in quest of employment. Multitudes came seeking business opportunities of one sort or another. Dozens of cafés, barbecues, lunch rooms, automobile service stations, and grocery stores sprang into existence both in town and along highways. A large variety of other new enterprises were launched including oil field supply houses, lumber yards, tourist cottages, hotels, cot houses and tents, barber shops, general merchandise stores, clothing shops, furniture stores, picture theaters, and drug stores. Newcomers also established such service institutions as the *Kilgore Daily News*, a chamber of commerce, medical clinics, ice factories, bakeries, laundries, and garages.

The demand for housing far outran the supply, and all available space was pressed into service. The new citizens at least needed places to sleep, and many of them wanted room for the operation of a business. They were willing to pay high prices for the rent or lease of property, but were not interested in making purchases since it was uncertain whether they would remain at Kilgore long. Accordingly the owners of homes and business properties were besieged by

persons clamoring for available space, and rent soared to astonishing levels. Some merchants sold their goods and rented or leased their buildings for more than their businesses had ever earned. Thus the proprietor of a garage leased the property for $250 a month. The leasee made the place earn about $800 a month by subdividing it and renting space to a

FIGURE 3.—Hotel Kilgore, one of the buildings erected soon after the boom commenced.

mercantile firm, a drug store, a café, an automobile service station, and a bowling alley respectively. Home owners were unable to resist the clamor of people for rooms. First they rented their guest rooms; but soon the living room, dining room, and sleeping porch were housing strangers. Thus four- and five-room cottages, without water main or sewer connections, came to serve as apartment houses with the owning family occupying the kitchen. Garages were fixed up some and rented for human habitation. No old shack was sufficiently dilapidated and mean to escape occupation during the early stages of the boom.

Even such adjustments did not enable existing buildings to house the multitude. Vacant lots and portions of lots were leased or rented by newcomers, and hastily equipped for occupation by setting up a tent or other temporary structure. Brick and stucco buildings were rushed to completion on some plots well located for business utilization, and aggregations of oil field shacks and improvised dwellings were erected in fields, pastures, and woodlands located on the outskirts of the town. Many small structures were built on wheels where lumber and labor were cheaper, and brought to the oil field as automobile trailers for use as business and residential properties. Men who could not or would not pay for quarters invaded the churches and slept on the pews and the floor. Others resided in tents, automobiles, and rude structures made of poles, posts, railway ties, sheet metal, card board, pine brush, and jute bagging. Some endured the cold of the winter without other shelter than that provided by trees with perhaps a windbreak to the north of the camp-fire.

DEVELOPMENT OF THE OIL INDUSTRY

Of course the oil industry developed rapidly at Kilgore. There was a brief period of active speculation in lease and royalty rights while test wells were put down on the outskirts of proven territory. The relatively soft formations of the Gulf coastal plain enabled fish tail bits to bore down rapidly, so that wells were sunk to the Woodbine (oil bearing) sand at depths of some 3,600 to 3,700 feet in a fortnight. Derricks built of pine timber or steel rose in steadily widening circles about the discovery well until the eastern and western limits of the pool were located. Thereafter expansion continued toward the north and south until the producing area merged with that developed about the Lathrop and Joiner discovery wells respectively, proving that there was one large oil field rather than three smaller ones. As more and more wells were com-

pleted, gathering pipe-lines were laid to railroad sidings. Here loading racks were erected, and trainloads of petroleum were shipped to refineries on the Texas coast and at important inland centers. Storage tanks were built in the oil field, pipe-lines were laid radiating from the producing area to principal markets, several small refineries (skimming plants) were established in the region, and gasoline was offered for sale at about half its former price.

The hurried development of the industry choked the railroad with freight. It was reported that the International-Great Northern had a net operating income of $437,677 for the first quarter of 1931 as compared with $17,574 for the same period during 1930, the year preceding the boom. Trucks laden with pipes, lumber, boilers, drilling equipment, and other supplies streamed incessantly toward the oil field. Metropolitan papers published in Dallas and Houston frequently contained accounts of activity in the area. Almost every day some new tests were "spudded in," and frequently the producing area was extended by the completion of gushing wells. Boom towns were being established, and agricultural villages were becoming cities. Great oil wells accidentally caught fire, and for a time defied all efforts to extinguish the flames. Fires also destroyed much business and residential property in the boom towns. There were fatal accidents in the oil field. Local peace officers and Texas rangers were rounding up "undesirable" and suspicious characters. In short so many interesting things happened in the oil field that people throughout the section read, talked, and thought about the development and problems of that area; and very many visitors came just to see the place.

FIGURE 4.—One of the rambling frame structures erected to house transients of moderate means at Kilgore. Cot houses and tents catered to a still poorer class.

This extensive development of the oil industry in eastern Texas was untimely. Unfortunately it occurred during a period of general economic depression when world markets for all commercial staples were contracting. Moreover the oil industry had been suffering for some time from chronic overproduction, decreased earning power, and depreciation of the stocks of operating companies. Demoralization became so general that operators resorted to proration in order to limit production and so increase their selling power. Under this plan each petroleum field, recognized as a separate producing unit, was assigned a certain "allowable" daily output, and local operators were pledged to choke their wells down enough to keep production within the specified limit. Thus the output of crude oil was reduced and the industry was regaining stability when the East Texas field began to pour its soaring output upon the market.

The discovery well near Kilgore came in December 28, 1930. Earlier in that month some good producers were completed several miles farther south in the Joiner area, and during the following month (January, 1931) the first gusher in the Lathrop or northern part of the field was dis-

FIGURE 5.—Typical dwellings built at Kilgore during the boom.

covered. In each area offset tests were promptly made, and those which became producing wells extended the proven territory. Then other tests were made farther from the discovery wells, and those which were successful further extended the producing areas. Thus the great East Texas oil field developed about three separate nuclei; at first slowly because the areas involved were small, but movement was accelerated as the proven territories expanded.

By the middle of March development was proceeding rapidly. The entire East Texas field had only 56 producing wells, but there were more than 200 drilling operations. The Joiner area, where development started earliest, led in number of oil wells with 39, the Kilgore area ranked second with 14 wells, and the Lathrop pool had only 3. About half of the drilling operations were in the Joiner sector, while the Kilgore and Lathrop areas respectively had 65 and 45. By May 21 it was reported that the East Texas field had produced more than 17,000,000 barrels of petroleum. Late in that month the average daily output reached 350,000 barrels, and the top price received for crude oil fell to 37 cents a barrel. Nevertheless rapid development continued, and by July 8 there were 1,100 producing wells in the great East Texas field which had an average daily output of about 380,000 barrels under severely restricted flow due to a lack of marketing facilities and efforts to enforce drastic proration orders. This mounting flood of oil from eastern Texas so demoralized the market that the average sale price slumped to about 16 cents a barrel, and many independent operators were said to be on the verge of financial ruin.

Yet the situation continued to grow worse. Much land in the 35-mile long oil field[1] was still partly or altogether undeveloped, and the owners realized that the producing wells of others would slowly drain away their petroleum unless offsets were sunk. With virtual certainty that each well would be a gusher, it was rather easy to secure capital for drilling. Therefore the number of wells and the volume of production continued to increase. There were so many "independent" operators having but one or a few wells that it seemed impossible to secure thorough coöperation in restricting production to the proration allowable. Some operators refused to coöperate for the common good, and their short-sighted action became an excuse for excessive production by others. Continued overproduction and the willingness of operators to undersell each other drove the price of petroleum down to ten cents a barrel while many people in Kilgore were paying that much a gallon for pure drinking water which was being shipped in, bottled, and delivered to consumers there.

Obviously the time had come for

[1] Plate I, Bulletin 3138 of (Texas) Bureau of Economic Geology, published October 8, 1931, shows the maximum length of the field as less than 35 miles; but several extensions were made to the oil field later, and people in the area say that it is about 40 miles long.

decisive action of some sort. The greatest oil field that had ever been discovered in Texas was being quickly dissipated, allowing salt water to flow into the oil sand so rapidly as to cause "enormous physical waste of crude petroleum." Also vast quantities of natural gas, "rich in gasoline content," which escaped from the sand with the petroleum were being wasted—burned in great torches (flares) through which it is discharged

FIGURE 6.—Fairly substantial temporary dwellings at Kilgore. People who migrate from place to place following the "play" of the oil industry invest more capital in automobiles than in residences.

because of the lack of profitable outlets. An enormous irreplaceable mineral resource was being ruthlessly exhausted under conditions which prevented the producing companies, land and royalty owners, and the state from deriving commensurate returns. Was it not time for the people of the district and state to thwart this wanton and profitless exploitation?

The Governor called a special session of the Texas legislature to consider the matter. A law was promptly passed declaring that "neither natural gas nor crude petroleum shall be produced, transported, stored or used in such manner or under such conditions as to constitute waste." When it became evident that many operators were determined to disregard the conservation law and that neither the commission charged with enforcement nor the local peace officers could control the situation, the Governor proclaimed martial law in the district (August 17, 1931), and sent a body of militiamen into the area under orders to close down every well in the field.

Thereafter the oil industry in the Kilgore area was much more orderly. Active drilling continued, but production ceased and the prices offered for crude petroleum advanced accordingly. On September 5, after a nineteen-day shut-down, orders were issued permitting resumption of production and restricting each well to a daily output of 225 barrels. Beginning September 19 production was further limited to 185 barrels because

FIGURE 7.—Drilling oil wells near Kilgore. The boilers are placed at considerable distance from the well to reduce the danger of fire when the gusher comes in spurting petroleum to the top of the derrick.

there were then almost 2,000 wells in the field and the output was mounting above the proration allowable of 400,000 barrels daily. Further reduction in the allowable per well kept the total production roughly within proration limits, troops continued to enforce executive orders, and the situation remained generally satisfactory.

At the end of December, 1931, one year after the discovery of oil at Kilgore, there were some 3,600 producing wells in the East Texas field, the price of petroleum was ranging above 60 cents a barrel, and the daily output of each well was limited to 100 barrels. The rising price of crude oil was stimulating continued development of the field and convincing operators of the necessity of regulated orderly production. With a view to further improving conditions the daily proration allowable for the field was reduced to 325,000 barrels, and the price of crude oil advanced to about $1.00 a barrel. By the first of May, 1932, there were more than 5,100 wells in the East Texas oil field, the daily allowable per well was fixed at 61 barrels, and even under such narrowly restricted flow the average daily production amounted to approximately one-seventh of the total for the United States.

TRANSPORTATION FACILITIES

Rapid development at Kilgore exerted severe strain upon local transportation facilities. Extraordinary demand for lumber, drilling machinery, oil field supplies, pipe-line equipment, building materials, food, and general merchandise induced heavy inbound traffic both by highway and railroad; and the flow of an increasing number of gushing wells enabled the shipment of train loads of petroleum. Existing transportation facilities were quite unable to handle this vastly increased traffic efficiently.

Kilgore's one railroad made strenuous efforts to meet the emergency. An excellent freight station was erected at Kilgore, and some improvements were made at the old station. Much new side track was laid to facilitate the movement of trains and to serve as team tracks and car storage. Additional water and fuel stations were established, and the number of employees at the local agent's office increased from one at the outset to twenty-eight during the peak of the rush. These efforts of the railroad to meet the demand for its services were rewarded by an increase of average monthly gross receipts at Kilgore from $3,000 for 1930 to $600,000 for the first half of 1931. But local shipments declined rapidly as pipe-lines were completed providing cheaper transportation of petroleum to market.

Highway and street facilities were much less responsive to the heavy traffic induced by the boom. At the outset two of the three highways which converge at Kilgore were surfaced with iron ore (limonite) gravel, and the other one had a macadamized surface. The heavy truck and automobile traffic formed chug holes and ruts in these roads much faster

than maintenance forces made repairs, and the rainy weather of winter and spring kept them muddy much of the time. As a result the highways were almost impassable at times, and during rainy periods it was exceedingly difficult to deliver materials at places some distance from the main roads. In Kilgore dense traffic and recurrent rain made streets so muddy that in the business section pedestrians paid ten cents to be "ferried" from curb to curb by mule-drawn sleds. When summer came some streets and highways were treated with oil which helped prevent the formation of dust and mud. Therefore traffic conditions were much better during the second winter (1931–1932), but unpaved streets in the business section and side roads again became very rough and at times they were so muddy that automobiles mired down. However along highways needed repairs were made promptly, in the business district one block of pavement was already down, and it seemed probable that a more extensive paving program would soon be under way.

FIGURE 8.—A burning oil well at Kilgore. The dense black column of smoke rises high into the air and drifts away with the wind. The forest and the valley location of the well obscured the roaring flames.

PUBLIC HEALTH AND SANITATION

Such boom towns as Kilgore invariably have rather serious health and sanitation problems during the rush period. Inhabitants of the village were accustomed to secure water from private wells, and there were no municipal water supply and sewage disposal systems. When the oil boom brought several thousand people to Kilgore, existing wells failed to adequately supply them with water for domestic use, and the congested population increased the danger of pollution. In part this situation was met by firms which shipped pure water to Kilgore by railway car and truck to be bottled and retailed in the local market. But such water was costly, and many people continued to use local supplies rather than make needed purchases.

Obviously the situation was bad in cottages used as apartment houses although they had no water main or sewer connections; but it was much worse where people crowded into tents and other improvised residences, especially those which had no sanitary facilities. As summer advanced there were some deaths from typhoid fever, and a sanitation and immunization campaign was made to avert an epidemic. Physicians im-

munized their respective patients, and coöperated with the local charity organization in extending this service to some 1,500 persons who were unwilling to pay for the treatment. After school opened in the autumn, diphtheria broke out among the children. This crisis was met by another immunization campaign with the charity organization offering treatment without charge to children who could not pay. In the meantime the local health situation was much improved by the drilling of deep wells, the establishment of an adequate city water system, and the laying of sewer lines.

FIGURE 9.—Landscape at Shell Camp, Kilgore, where employees of Shell Petroleum Corporation are housed.

THE CHURCH

The oil boom profoundly altered religious organizations at Kilgore. There were three small frame churches at the outset, each of which was on a circuit. Services were held at the Methodist church on the first and third Sundays of the month, while Baptists and Presbyterians respectively had church on the second and fourth Sundays. A "small and restless" congregation of Presbyterians were worshiping at the time the Bateman-Crim discovery well came in. Then the boom set in, and hordes of unkempt men entered the church buildings establishing themselves there. They turned on the gas heaters and slept on the benches and floors. As defense measures the doors were locked and the gas was cut off, but the bold invaders opened the doors and turned the gas back on. They littered the buildings with soiled paper, rags, mud, and discarded bits of food. Indignant church ladies cleaned up the muss and deloused the buildings so services could be held, and ministers tried the expedient of preaching to the invaders each night. Such mild measures were of no avail, and at length the Baptists authorized the use of their building as a jail. Heavy chains were fastened in the place so prisoners could be handcuffed to them for safekeeping. Then keys to the Methodist and Presbyterian churches were given to policemen, and invaders were arrested and locked up.

Thus two churches were reclaimed, but as a whole the people exhibited little interest in their activities. They were engrossed in a mad race for wealth, and seemed to realize that they must either win quickly or fail. Business and industry were about as active on Sundays as other days. The new people had not come to worship God, and some of the "old timers" took a vacation. Church budgets were balanced without difficulty, but revival meetings attracted little interest.

A final shock came to the old churches during the summer. The declaration of martial law and arrival of militiamen were signals for a series of incendiary fires; and on Sunday, August 23, both the Methodist and Presbyterian churches burned to the ground. Thus Kilgore became a churchless city for, after serving as jail, the Baptist building was moved to another site and used first as a dance hall and later as a store.

On the whole the destruction of the old churches seemed to have a desirable effect. It occurred as the oil field was settling down to more orderly operation and as the population of the new Kilgore was beginning to achieve some community solidarity. The religious people were stirred to the task of erecting churches commensurate with the increased wealth and importance of the place. The Presbyterian congregation set the pace by the erection of an attractive modern brick building at a cost of about $25,000, and the Baptists and Methodists were actively preparing for similar undertakings by the end of the year.

FIGURE 10.—The old school building at Kilgore.

THE SCHOOL

The boom occasioned much less interruption of the public schools than of the churches. Oil field rabble did not seriously invade the building because school was in session and the property was occupied. Also during the first months, arrivals were chiefly men, and the increase of school population was relatively small. Nevertheless, the school became badly congested as the total white enrollment increased from 225 to 350.

Since many men who located in Kilgore did not bring their families until the peak of the boom was past, the school escaped being swamped during the rush and evolved into an urban institution in relatively orderly fashion. The woman and child population grew rapidly during the summer and early autumn as housing facilities commenced to overtake the demand. Accordingly an emergency was anticipated at the opening of the 1931–1932 school session, and extensive preparations were made to meet it.

A man having extensive graduate training in school administration and experience in oil field situations was placed at the head of the Kilgore independent school district. After making a survey of the situation, this educator divided the district into neighborhoods and planned the erection of a school in each of them. Available funds were much too small to finance this comprehensive building program because the school tax based on property values as of January 1 produced only $7,500, and the school census for state aid apportionment was taken during March while the number of scholastics was still small. It was evident that additional funds were needed; and, when the matter was presented to them, oil companies and wealthy citizens responded generously with loans and even donations.

This enabled immediate erection of ten new frame buildings including a teacherage and gymnasium. Each building is of substantial type, well lighted, painted, and well equipped for use. Well-trained teachers, several of them holding the Masters degree, were employed; and when the term commenced, 1,841 white children were enrolled. By the middle of the session the number of white scholastics increased to 2,100 and there were some 600 colored children. In the meantime the number of white teachers increased from eight to

fifty and there were ten negro instructors. All work above the fourth grade was departmentalized, and the faculty was preparing a course of study for the grades and the high school designed to meet local conditions. In addition to the usual subjects, courses in music, speech, art, and band were offered. Plans for further development included immediate construction of a large brick high school building.

FIGURE 11.—There is some attractive new housing at Kilgore.

THE OUTLOOK OF KILGORE

What is the probable future of Kilgore? Will the place continue growing and ultimately become a center of outstanding regional importance, or will it remain a city of minor rank. Kilgore's location with reference to the East Texas oil field is the sole basis of its recent growth and of hope for future greatness. But unlike coal, petroleum can be cheaply transported by pipe-lines so that consuming industries do not find location in the producing field a paramount advantage. In fact this advantage is outweighed in many cases by such factors as superior transportation services, proximity to larger markets, and location in a more stable urban community. Thus much of the more permanent business and industry attracted by the developing oil field elected location in Tyler, Longview, or Henderson—small cities a few miles from the oil field—and some of it has gone to such distant centers as Dallas, Houston, and Shreveport. Thus, as Kilgore grew the better-established centers about it progressed, and on the whole their growth was more substantial than that of towns in the oil field.

The careers of other inland oil field towns indicate the probable future course of events at Kilgore. Such places tend to develop quickly and then become stabilized as the oil field settles down to sustained production. But petroleum is so easily withdrawn that its extraction proceeds rapidly, and when the store of mineral wealth begins to fail the community tends to decline sympathetically. While production remains large, a considerable population is employed operating wells, casinghead plants, petroleum refineries, and the local business and industry which develops in the town. But when the wells fail, population shifts to areas of greater activity, local business and industry are constricted, and community disorganization sets in.

With but one railway and the competition of larger urban centers nearby, Kilgore has little chance of securing regional leadership in business and industry. Failing this it will doubtless remain primarily an extractive or exploitative center, and when at length salt water rises in the oil wells, an economic crisis will occur. The population must secure other employment or migrate, and unless new industries and businesses are developed, community decline must occur. However, the decline will probably be relative rather than complete because by that time much fixed capital will have been invested

in durable business and factory buildings, in residences, and in paved highways and streets. Such improvements constitute more or less permanent community assets, and will prevent decline to a purely cotton farming base. Low rents and depreciated property values will tend to stimulate use by some sort of business or industry, and Kilgore will maintain itself well above the level which preceded the boom. Such is the cycle of the interior oil field town.

WHERE FLORIDA TRUCK CROPS ARE GROWN

John L. Wann

FLORIDA is a land where agriculture takes its place in the United States largely because of its climate, soil, water protection, comparative market costs, competition of various crops for the use of the land at the same time, location of the population of the United States, nearness to railroads, nearness to motor highways, drainage and irrigation, and topography.

Climate

Since Florida is the farthest south (Fig. 1) of the states of the United States, extending as a narrow strip of land far out into the ocean and thus nearly surrounded by the Atlantic Ocean and the Gulf of Mexico, and in addition, since it has vast numbers of inland lakes which lend local influence, it has a climate of sub-tropical character (Fig. 2). This warm climate accompanied with much rain and sunshine at certain seasons makes the growing of crops "out of season" (in winter) comparatively easy and oftentimes very profitable to the grower. Its climate includes an annual rainfall of from 50 to 65 inches, and there is sunshine in some sections nearly every day in the year.

In much of the state the first killing frost of the fall or winter does not occur until December (Fig. 3), and many times the last killing frost is in February or March (Fig. 4).

Soil

A very considerable portion of Florida soils is sandy with only a small amount of organic matter (Fig. 5). However, within this vast sandy area there are numerous places where the soil contains considerable organic material and is covered with thick growth of trees and other vegetation. These are termed "hammocks" and are well adapted to the production of truck crops.

Certain other parts of this sand are known locally as "high pine" lands, while others are "blackjack" lands. These are characterized by color, texture, and the growth on them. They are poor in quality and are not suitable truck crop soils, except for such crops as watermelons and cucumbers. There are other small areas to the North containing considerable clay. They have the ability to produce good truck crops, but the location is so far north in the state that it lacks the climatic advantage for winter trucking.

Farther south toward the end of the peninsula, much of the soil is underlaid with coral rock. Along the beaches on both the West and East coasts are large deposits of beach sand. These are not conducive to extensive trucking.

There are a few large deposits of muck land in the state which are not always in close proximity to one another. The largest body of muck land is around Lake Okeechobee. There are others on the West Coast and on the East Coast. The mucks are rich in humus and plant food. Many of them are splendid trucking areas, especially after they have received certain chemical treatments.

FIGURE 1.—Relief model of part of North America including a part of the Floridian Plateau. Florida is located farther south than any other state of the United States, being mostly below the latitude of 30° N. (By permission of Doctor Herman Gunter, Florida Geological Survey, 1927–1928.)

There are many other soils scattered over the state which may be characterized by their color, texture, or amount of organic matter. Some of them seem to be especially fitted for growing specific truck crops. The potato areas of Hastings and LaCrosse are good examples, also the two large celery areas, one at Sanford and one at Sarasota and Manatee. This Sanford soil is also typical of soils which are different because of the subsoil. In this case there is a hardpan substratum which has a water holding capacity, thus making it possible for sub-irrigation.

WATER PROTECTION

Possibly this factor is more important than it would appear at first to be, in this state. Since the nearness of water influences temperature changes because of the fact that water temperatures vary to a lesser degree than the land, truck growers have found that locations near a lake or large river give protection. This is held to be true for the Federal Point district in the potato area, for certain parts of the Sanford celery area, near almost any lake, and in a much larger way along the Atlantic Ocean and the Gulf of Mexico.

On the other hand, nearness to water in some instances brings on damage from salt water, also from fresh water. Some of the good truck lands around Terra Ceia in Manatee County and in the vicinity of Homestead in Dade County are so low that high winds blow salt water inland. This not only destroys the immediate crop thereon, but also damages the soil to the extent that it sometimes requires a few years for recovery. A few of the Florida rivers overflow their banks on to trucking land. This is not as usual here, however, as it is in some other states. There is a more destructive fresh water damage. One occurs in the trucking area around Lake Okeechobee. Sometimes rains cause the lake to rise over its banks. Also, high winds blow the water far out over the low flat muck land. On the other hand, when the water level is too low in this same country this muck land dries out and devastating fires consume the peaty soils.

MARKET COSTS

This state has the fortunate privilege of being located nearer to the

great northern and eastern markets than any other state producing crops in the winter. The costs of greenhouse production in winter in the northern states are high. Therefore, the market costs are favorable to Florida until the more northerly states start producing in the early spring.

CROP COMPETITION FOR LAND

As to the competition of crops for use of the land, much depends upon the judgment of each individual grower. He must decide which crops will thrive best upon that land under the climatic conditions. Also, he tries to foresee whether certain crops will command a higher profit in the northern markets when harvest time arrives.

POPULATION

The fact that there is a vast population of consuming people located in the North and East part of the United States near enough to make it profitable to grow truck crops in Florida "out of season" and ship them to these markets is no doubt an important factor determining why truck crops are produced in the state of Florida. It does not seem likely that any portion of the United States population strongly influences the location of trucking areas within the state except as this factor is linked with the time element and with the marketing costs. These enable the location of growing areas to march up the state as the season advances and more northerly parts of the state each year successively come into production.

In a small way perhaps the population of Florida and more surely the winter tourist population in Florida, influence the location of some areas,

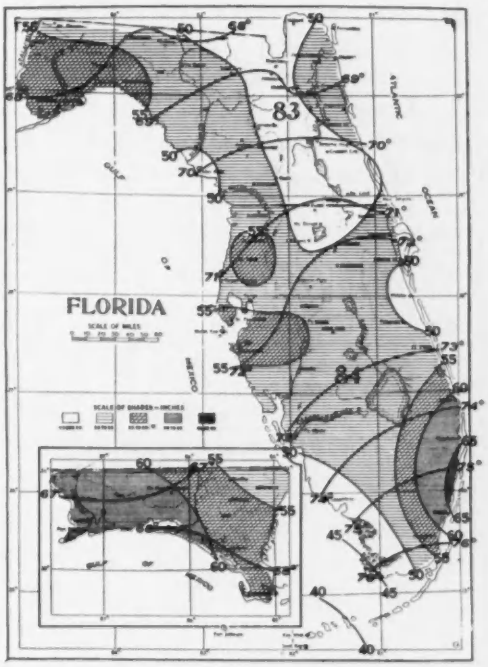


FIGURE 2.—Normal annual temperature and precipitation, as compiled from all available records to 1917 inclusive. Lines with numbers and the degree mark (°) at the end indicate temperature; shade portions indicate inches of precipitation during the year. (From Florida Experiment Station Bulletin 200.)

but this is not thought to be a large factor. However, it increases the size of the areas to some extent. Only a small acreage could satisfy home demand. It seems probable that other states consume vastly more of nearly every Florida truck crop than Florida itself, yet it is true that the large cities of Florida are near several of the trucking areas and take part of the products produced (Fig. 6).

NEARNESS TO RAILROADS

There was a time in the history of Florida when nearness of farm land to a railroad determined largely whether crops could be produced and sold. It is still very important, but with the network of mile upon mile of good motor highways making easy trans-

portation to markets and to the railroads, it is doubtful if many stop to realize the advantages of railroads. The citrus, potatoes, and other semi-perishable products were hauled by oxen and wagon in earlier days only

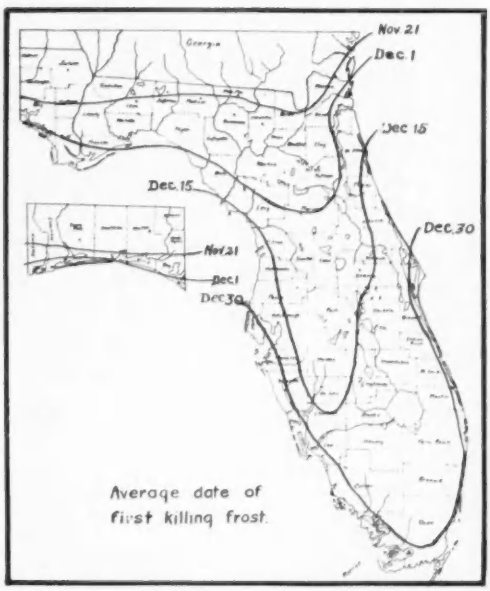


FIGURE 3.—Average date of the first killing frost in fall or winter in Florida. (From Florida Experiment Station Bulletin 200.)

about 20 to 25 miles on each side of the railroad. Many interesting stories are told of the lonesomeness of the haul for driver and ox team over seemingly endless miles of crooked tracks through the sand and forests, and how the drivers came to be known for the characteristic loud calls and exclamations to the oxen just to hear a human voice. Then the railroads in Florida truly were pioneers. Today the many railroads seem adequate for some years to come (Fig. 7), and movements afoot seeking to take up tracks in certain territories tell either of overexpansion or that their purposes (for mining and timber) have been fulfilled for the present time.

MOTOR HIGHWAYS

Now it is becoming less important to have a truck farm located within easy hauling distance to a railroad. There are many miles of good motor roads which make it possible to grow truck crops several miles from the railroad. These roads lead from almost every trucking area of the state (Fig. 8).

With the extended miles of splendid motor roads leading to every important market of the United States and with large motor trucks, sometimes even refrigerated, hauling truck crops as far as Washington, D. C., the transportation problem of Flor-

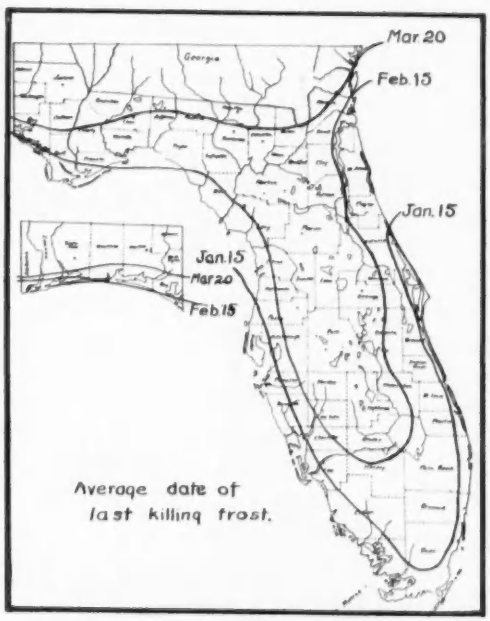


FIGURE 4.—Average date of the last killing frost in winter or spring in Florida. (From Florida Experiment Station Bulletin 200.)

ida agriculture has taken on new complications. The rapid change of prices at the consumer end ceases to cause the question "can produce be transported to market," as of Florida pioneer days but it now is "how

quickly can the produce be transported"?

Not every available section of the state has been reached with transportation facilities but immediate needs likely have been met.

consider is advisable. In many sections of the state small-scale drainage is resorted to by individuals in order to grow crops. This applies to most farmers growing crops on muck lands or on flatwoods lands.

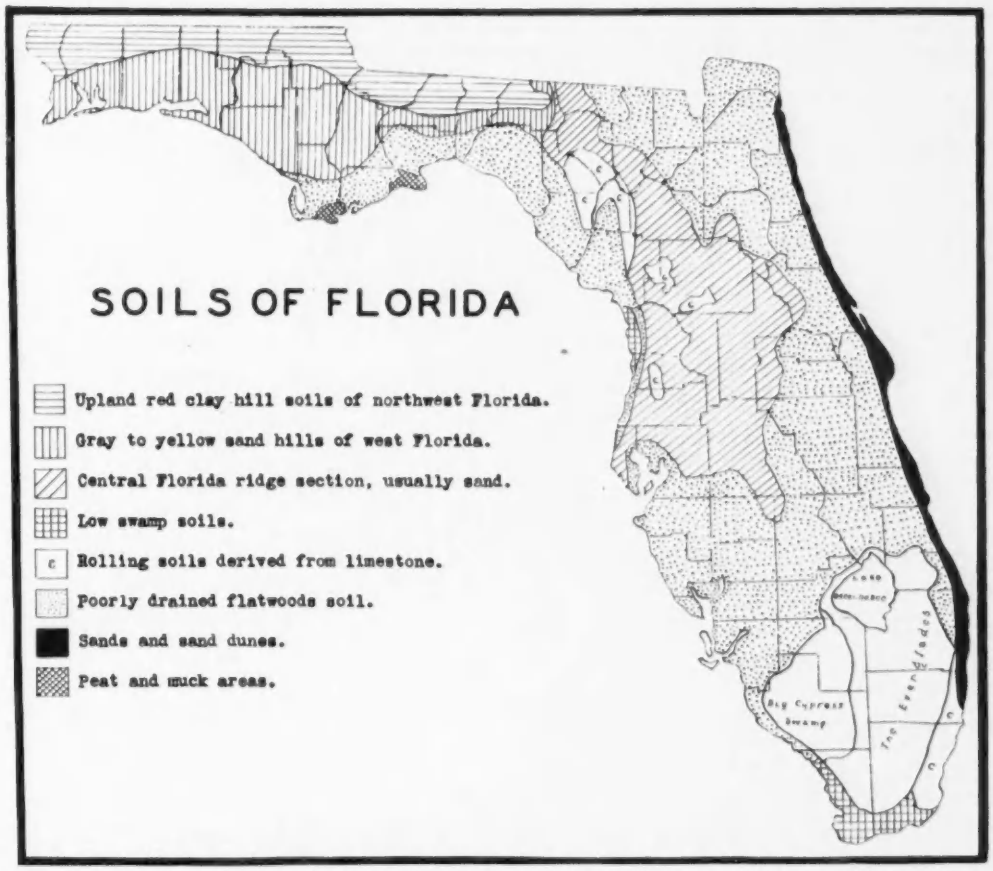

SOILS OF FLORIDA
Upland red clay hill soils of northwest Florida.
Gray to yellow sand hills of west Florida.
Central Florida ridge section, usually sand.
Low swamp soils.
c Rolling soils derived from limestone.
Poorly drained flatwoods soil.
Sands and sand dunes.
Peat and muck areas.
Big Cypress Swamp
The Everglades

FIGURE 5.—The soils of Florida are made up of a good many different varieties, as will be seen from the above map. (Bennett, Bureau of Soils, U. S. D. A.)

DRAINAGE AND IRRIGATION

Some of the largest trucking areas are where they are, due to drainage. There are numerous canals (Fig. 7) in the Everglades district which take off the water, thus enabling crops to be grown on these low lands. There are those who feel that drainage has been overdone. During dry seasons the water level is lower than they

Florida uses at least three methods of irrigation—overhead, surface, and sub-irrigation. Most of its irrigation is carried on by individuals or by two or three men working together. There is no great irrigation project involving large dams and reservoirs for surface irrigation, but many instances can be found of growers using pumps to lift the water out of lakes, rivers and canals. This water is

conveyed over the fields by jointed pipes, also by use of surface runways made of soil. There are many other instances of surface irrigation making use of artesian wells. Sub-irrigation is practised extensively where the subsoil is of such character as to give it water holding capacity. The Sanford area is a good example of this method. Irrigation devices are used to tide the crop over short periods of drought. These dry times are not always regular and in some seasons they do not occur at all.

TOPOGRAPHY

The topography of Florida cannot be fully understood until it is taken into consideration that the state is a plateau (Fig. 1). The highest surveyed points are about 320 to 330 feet above sea level. One place is at Mountain Lake in Polk County. It is 330 feet above sea level. Another is at Round Lake in Jackson County, and is 322 feet above sea level. The downward slope of the plateau extends from these points to the water level and thence on down gently ex-

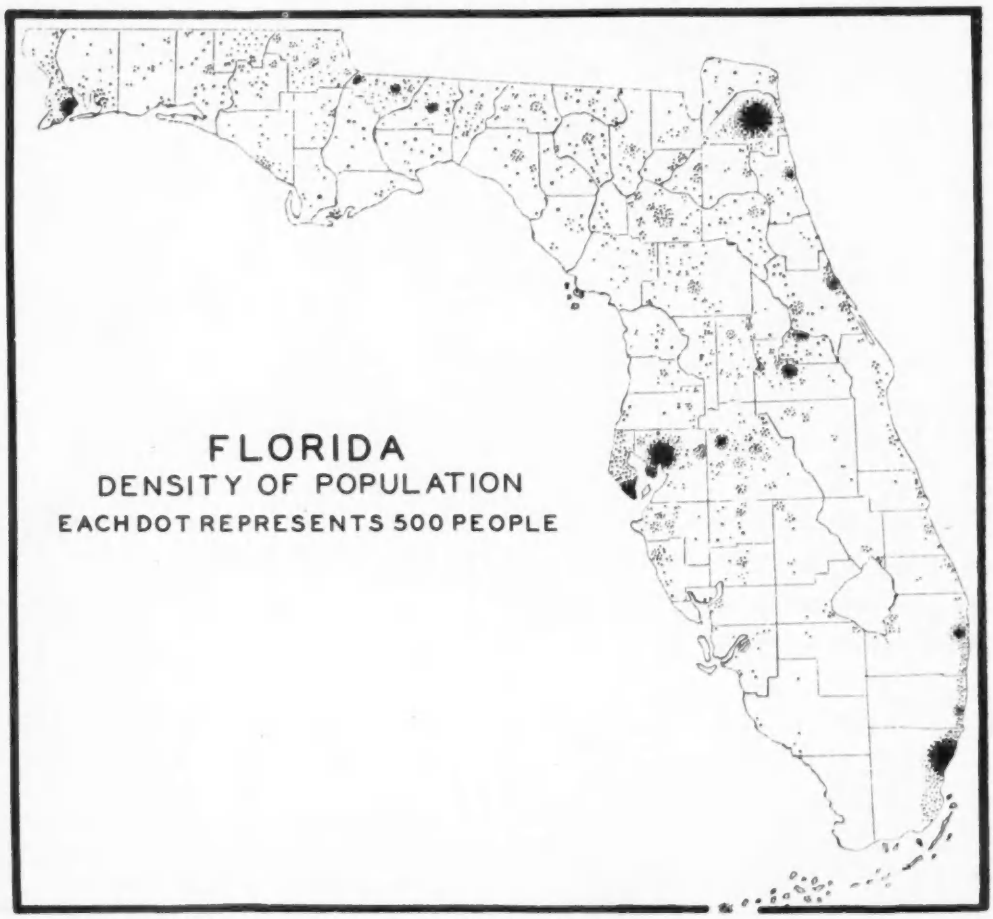


FIGURE 6.—The density of population in Florida. Each dot on the above map represents 500 people.

FIGURE 7.—Railroads and canals of Florida.

tending under the water to a distance of a few miles when a more sudden drop occurs on either side of the peninsula to a depth of a few thousand feet in some places. Thus it can be understood that the peninsula of Florida is only a lower plateau of the Appalachian range. The state's surface is considered to be level and gently rolling in some of the interior sections. Large acreages on the south and in some places along the Gulf of Mexico and the Atlantic Ocean are so low that water stands for many months to a depth of several inches.

A more detailed discussion of the marketing and production competition among Florida truck crops is given in Bulletin 238 which contains maps for the 17 most important truck crops. Areas are designated for each crop and are shown on the maps by means of shadings and hatchings. Tables for each crop are included showing weekly shipments by counties and by areas. Anyone interested in a more detailed description can obtain this publication from the Florida Experiment Station, located at Gainesville, Florida.

CHANNELS OF TRANSPORTATION

Of a total of 50,705 equivalent carloads of truck crops which went out of the state during the 1928–1929 season, 1,871 carloads or 3.7 per cent went by boat (Table 1), 4,037 carloads, or 8 per cent, went by express, and 44,792 carloads, or 88.3 per cent went by freight.

Of the nine major crops, green beans, peppers, and strawberries figured high in the movement by express, while the percentage of tomatoes, peppers, and early white potatoes going by boat was rather high. In April, 1932, the motor truck method of transportation became rather important in the state, but its volume is not included in these data. There is also some transportation by the rivers and canals of certain crops grown along these canals and rivers.

FIGURE 8.—Main motor roads of Florida.

MAJOR CROPS

In locating the truck crop areas of Florida, volume of shipments for a definite period was the first consideration and thus nine commodities were found to occupy the major position in the state.

TABLE 1

QUANTITIES AND PERCENTAGES OF FLORIDA TRUCK CROPS, SHIPPED BY DIFFERENT METHODS, SEASON 1928–1929 *

Crop	Equivalent Carloads			Per Cent of Total Shipped		
	By Freight	By Express	By Boat	By Freight	By Express	By Boat
Watermelons	9,960	.....	...	100	.....	....
Celery	8,731	17	2	99.8	.2	†
Tomatoes	7,169	241	845	86.9	2.9	10.2
Green beans	3,116	2,043	133	58.9	38.6	2.5
Early white potatoes	4,907	14	342	93.2	.3	6.5
Cabbage	3,034	5	134	95.6	.2	4.2
Cucumbers	2,159	145	4	93.5	6.3	.2
Peppers	1,613	329	357	70.2	14.3	15.5
Strawberries	1,620	524	1	75.5	24.4	.1
Lettuce	902	34	...	96.4	3.6	....
Escarole	675	1	...	99.9	.1	....
Eggplants	202	116	11	61.4	35.3	3.3
Romaine	290	3	...	99	.1	....
Green corn	272	21	...	92.8	7.2	....
Squashes	22	179	35	9.3	75.9	14.8
Okra	.....	227	...	.....	100	....
Green peas	31	85	3	26.1	71.4	2.5

* Crops shipped in less than 100 carloads per year omitted, also fractional carloads omitted.
† Weekly shipments of less than .1 carload omitted.

For some crops the areas are marked geographically with rather definite boundaries, as with celery and early white potatoes. Some others (*e.g.* green beans and cabbage) are grown over much of the state so far as geographical location is concerned. These have other limiting factors as well as soil and climate. They are market advantages, and competition of other crops on the same land at the same time. These latter crop areas are not so definitely marked, as can be seen by the figures, however, the concentration of shipments moves up the state very regularly with the advancing season.

TABLE 2

TOTAL EQUIVALENT CARLOT SHIPMENTS OF FLORIDA MAJOR TRUCK CROPS, SEASON 1928–1929

Crop	Equivalent Carloads
Watermelons	9,960.2
Celery	8,749.8
Tomatoes	8,255.4
Green beans	5,291.7
Early white potatoes	5,262.2
Cabbage	3,173.1
Cucumbers	2,307.5
Peppers	2,299.3
Strawberries	2,144.8

It will be impractical as well as impossible to show how each factor previously discussed plays its part in locating each commodity. For with some commodities not every factor has functioned perceptibly. For others it appears that perhaps one or two factors are mostly responsible for the location of the area.

In an attempt to convey an idea of the areas for several truck crops, the intensity of the production can be revealed with data gathered in 1928–1929 concerning all the shipments of truck crops from the state by freight, express, and boat. The shipments have all been reduced to equivalent carloads and are shown by counties for each truck crop here discussed. No doubt some shifts of areas occur from year to year, but when viewed as a state the areas do not likely shift

FIGURE 9.—Scoring a farm home in a home improving project. All lumber and rock used in building this house came off the farm. Home of Mr. and Mrs. J. D. Williams, Marion County, Florida. An example of beautiful simplicity. (Courtesy of University of Florida.)

often except as long-time changes occur.

WATERMELONS

Taking up the list of major truck crops, watermelons led in 1929 on the basis of volume of shipments. They were moved from the state from near the middle of April in Hendry and Lee Counties in the far southern end of the state, to the middle of July in Jackson, Suwannee, and surrounding counties. There can be said to be at least four important areas within the state. The real significance and definiteness of these areas, as well as with many other truck crops, can be shown only when one studies the time when they started to ship, when they had their peaks, and when and why they ceased to ship. The time of shipments march right up the state, controlled by climate to regulate the growing periods and by market conditions to regulate whether the nearest southern area will continue to ship after its near northern area within the state starts to ship.

For example, the extreme southern area, including all counties south of Polk County, and designated as Area 1, came on the market first during the week ending April 20, with 5 carloads. The peak of shipments for that area occurred about May 11, when 85.2 carloads were shipped. The next area to ship was number 2 (including Marion, Sumter, Orange, Polk, and Lake Counties), which started the week ending May 4; then came Area 3 (including Alachua, Gilchrist and Levy Counties) the week ending May 11; and the week of June 1, Area 4 (all counties north of Alachua, also West Florida) started shipping. The peak for Area 3 occurred the following week. Two weeks later, June 22, Area 4 had its peak, and shipped 1,177 carloads. In each case, when the northern area came on the market strongly, the area next to it on the south dropped off and soon ceased to ship. The climate alone did not regulate this, neither did the type of soil, because watermelons could have grown in the southern areas right on in some cases for several weeks, but the cheaper

FIGURE 10.—A celery field almost ready to cut (Manatee-Sarasota Area). This grower has his own water system for his dwellings, and everything has a permanent aspect. (Courtesy of Chamber of Commerce, Bradenton, Manatee County, Florida.)

market costs of the northern areas in their turn gave them the comparative advantage just as soon as the climatic conditions became favorable. Thus climate and market costs are important locating factors for watermelon areas in Florida.

CELERY

With celery the conditions locating the areas are somewhat different. Using volume of shipments to indicate the intensity of growing of the commodity in each county, there are two distinct celery-growing areas. The bulk of celery moved from only three counties—Manatee, Sarasota, and Seminole. In fact 73.6 per cent of the total carloads from the state originated in Seminole County.

There is another district (Brevard County), though small it is unique in that it marketed its 32 carloads of celery late after the other areas had ceased to ship. The time element here was important.

Perhaps no other commodity in the state shows a better picture of growing areas and in this case the areas are determined because of climate, soil, and the time the product can be placed upon the market.

TOMATOES

Tomatoes are grown for market over most of the state south of Union County, and they can be produced around Homestead in Dade County continuously from early November to the end of May.

FIGURE 11.—Tomatoes growing in Area 3. These are supported by stakes to keep the tomatoes off the ground and thus help prevent disease spread. (Courtesy of Chamber of Commerce, Bradenton, Manatee County, Florida.)

In studying production and shipments from the state one does not get an impression that there are very definite tomato-growing areas, yet the extremely mild climate of the southern end of the peninsula makes it possible to produce tomatoes there during the winter months. The state

has been divided into three large tomato-producing areas. Eleven southern counties constitute Area 1. To get an idea of the amount of intensity of the area it should be noted that 5,182 carloads were shipped during the year. These shipments extended over an extremely long season. Climate favors this territory for winter production. In some instances the soil is not good, in fact the flat marl is often barely covered. As to topography, the country is level with an elevation usually of only a few feet. In some sections sea-water comes in over the land, and in other parts fresh water stands on the land for some time during certain periods of the year. This Area 1 is farthest from market of any Florida tomato area, and so the costs for freight transportation are high. This is usually overcome by the fancy prices received for the products produced "out of season," and sold in the northern markets to those who are able to pay a premium for what they want. There is competition sometimes on individual farms of other crops for the land at the same time. When other commodities give promise of bringing greater profits, there is some acreage shift from tomatoes in this and other areas. Since there is so much available uncultivated land in any of the areas and since it requires comparatively so few acres to produce all the tomatoes the market will take at a satisfactory price, there is a tendency for the factor of competition for the land in the area not to be disturbing. It is an ever-present problem, however, on each individual farm.

Areas 2 and 3 naturally are farther up the state. The number of cars shipped, which again indicates their intensity of production, does not indicate that tomatoes will not grow there as well, but probably means that other crops displaced tomatoes. Another thing of interest is that Area 3 produced tomatoes for intensive shipment only for about four weeks. Thus cheaper market costs enabled this area and Area 2, to displace Area 1 as soon as the climatic conditions were favorable. There is no doubt, however, that these northern areas could have continued to produce even farther into the summer had it not been true that the climatic march up the country allowed other states to cut off entirely the production for shipments from Florida in summer.

GREEN BEANS

Probably every county in the state produces at least a few green beans and a production map of the state would indicate how universal a crop it is on a commercial scale. There were 5,291.7 equivalent carloads shipped during the season studied.

The areas are not so definite because so many counties grow them. Three of the areas are heavy producers as indicated by the shipments. They are Areas 1, 3, and 4. Area 4 (Broward and Dade Counties) started off early in November and continued to ship heavily until early April. Area 3 (all counties bordering on Lake Okeechobee) started the same week but had a high peak over a long season of ten weeks from the middle of February through April. Area 1 (Alachua, Marion, and Sumter Counties) had a fall crop and a spring crop, both of which covered narrow seasons and the spring crop shipped heavily with a climax of shipments April 27 after Area 4 had practically finished and Area 3 was on the decline.

It is evident then that with green beans, climate and market costs are

factors of location, and some growers and buyers working with them regularly believe that the kind of soil influences the quality to some extent.

FIGURE 12.—A home located on the St. Johns River, Hastings, Florida, in the potato Area 1, St. Johns County. Oak and magnolia trees, Spanish moss, bird pole on the left, and a dog, all render a home appearance. (Courtesy of University of Florida.)

EARLY WHITE POTATOES

For the season 1928–1929, Florida shipped 5,262.5 equivalent carloads of early white potatoes. This is an instance of a highly concentrated area in the face of the fact that many counties produce only a few commercially, yet the territory designated as Area 1 is becoming increasingly important. This is probably more largely due to the soil in this area which is highly adapted to potato growing. Area 1 is usually known as the Hastings area, and included in it are the smaller districts known by the shipping points of Bunnell and LaCrosse. In order to get an idea of its importance in the state it is shown in the figure that 4,779 equivalent carloads moved during the year from its nine counties, while the remainder of the total volume moved from 27 counties with no one of these 27 counties shipping more than a total of 70 carloads.

Area 1 had competition from other counties throughout the greater part of its shipping season. Some counties in South Florida, such as Dade, Indian River, Lee, Manatee, and St. Lucie, marketed a few carloads during a period of ten weeks before Area 1 began shipping. Light shipments were made as early as the week ending December 1. These counties have favorable soils and their climate is good for growing potatoes. The point is that other crops compete for use of the land. If the cost of early production is not too great, and a more valuable crop would not be displaced, this would indicate an opening for a greater production of early white potatoes in those few counties farther south where the climate permits. This would be especially true in January and February following years of a short crop stored in the northern states.

When the season for Area 1 was over, or practically over, Escambia County in the extreme west end of the state sent 46 carloads of potatoes to market. This county has the disadvantage of being too far north for early production, and is just far enough north to suffer competition from other states.

Since early white potatoes are not quickly perishable, they often move out by boat (Table 1). The St. Johns River, which is navigable, flows through the potato district to Jacksonville, where there is a port for large ocean-going boats to the northern cities. Of course by far the largest per cent of the crop was transported by rail.

CABBAGE

Cabbage is another important crop as shown by the fact that 3,173.1 equivalent carloads were shipped during the season of 1928–1929. The

reason for making six areas is first, because a large volume of cabbage can be grown on a small acreage and second, the time of shipment from the area. With the exception of Areas 1 and 6, the peaks of shipments were all within a period of three weeks' time. Area 1 had its peak on January 19, when it shipped a total of 60 carloads of cabbage. Area 2 did not reach its peak until March 23. The three weeks of March 9, 16, and 23 contain the peaks for Areas 2, 3, 4, and 5. This is not like some of the other crops, as the figure shows that Area 1 is halfway up the state and Area 2 is farthest north, yet it was second in time of heaviest shipments, and Area 3, which is farthest south of all the areas, did not ship its heaviest until in March. No doubt competition of other crops for the land has much to do with determining when and where cabbage is grown.

Due to the fact that cabbage is not so quickly perishable and since it can be used in large quantities, 96 per cent moved by freight during the year studied (Table 1).

CUCUMBERS

The shipments of 2,307.5 equivalent carloads of cucumbers, all in a comparatively short period of time, is a good example of the influence of climate and market costs. There are five areas. In some seasons Area 1 around Wauchula is on the spring market for a time unmolested by other areas. It was not so fortunate, however, in 1928–1929 because Area 2 (Sumter County) and Area 5 (Orange and Lake Counties) came along with it. By use of board troughs to cover the plants in cold weather, and by banking with earth, Area 2 can frequently come in with or near to Area 1. In fact, in 1929 Area 2 actually had its peak of shipments ahead of Area 1 and the peak was also higher. The peak for Area 5 came only one week later than that for Area 1, and the Area 3 (Levy and Marion Counties) peak came two weeks later than that of Area 5. The peak of Area 4 (Alachua County) was only one week later than that of Area 3. These represent intense producing areas and keen marketing competition.

About 94 per cent of the cucumbers moved out of the state by freight (Table 1).

PEPPERS

Within the state six pepper areas have been designated. Besides there were 17 other counties where peppers were grown on a commercial basis. The total from the state was 2,299.3 equivalent carloads.

Areas 2 (Broward and Dade Counties) and 1 (Hillsborough, Manatee, and Hardee Counties) led all others as to quantity put on the market. That part of the state usually known as South Florida and containing Areas 1, 2, and 3, appears to be the only place in the United States where peppers can be grown and marketed profitably throughout the winter. This is due to a favorable climate and because Florida is located near enough to market so that peppers can be grown, transported, and marketed at a profit in the heavily populated northern cities where a fancy price will be paid. In case there should occur a curtailment of importation of peppers into the United States, South Florida could increase its production, provided the production costs are not too high and provided that other more valuable crops are not displaced. Many more peppers can be used in the consuming centers

FIGURE 13.—Harvesting cabbage in Area 5. Shipments of cabbage are often made in hampers as shown in the above photograph, also motor trucks move much of it in the bulk. The peak of shipments for this area occurred in February. (Courtesy of Chamber of Commerce, Bradenton, Manatee County, Florida.)

than are furnished by the state of Florida.

STRAWBERRIES

Here is another instance of definite geographical location of producing areas. Soil is an important factor, as well as climate, and marketing costs.

An equivalent of 2,144.8 carloads of strawberries moved from the state, mostly within a period of nine weeks. There are three areas, two of which are large in volume of shipments. Area 1, known as the Plant City area, was first to come on the market, starting December 8. Two weeks later this area was shipping more than five carloads per week. It reached its peak March 2, with 324.3 carloads. Area 3, around Starke and Lawtey, reached five carloads February 23 and its peak of 97.4 carloads per week occurred March 16, only two weeks later than the peak for Area 1. The Winter Garden section (Area 2) did not have any time in which to ship unmolested by the other areas, but it is a definite and separate area several miles distant from any other area growing strawberries on a large scale. Its peak of 13.7 carloads moved the week ending March 2, the same date as the peak for Area 1, and its season ended before either of the other areas finished shipping.

SUB-MAJOR CROPS

Besides having a good many major crops, Florida also has a number of sub-major crops.

TABLE 3

TOTAL EQUIVALENT CARLOT SHIPMENTS OF FLORIDA SUB-MAJOR TRUCK CROPS, SEASON 1928–1929

Crop	*Equivalent Carloads*
Lettuce	935.9
Escarole	676.4
Eggplants	329.1
Romaine	292.6
Green corn	292.5
Squashes	236.5
Okra	227.2
Green peas	119.

LETTUCE

Here are other marked growing areas. Lettuce grows better and thrives where climate and soil condi-

tions are favorable, but competition of other crops for use of the land at the same time causes lettuce to be grown when it is and where it is. Lettuce is really a minor crop in Florida. For example in Seminole County (Area 1) it precedes celery, a major crop.

Apparently geographic location and climatic conditions did not fully regulate the time of production.

Area 1 was on the market first. It had its peak soon after Area 3 (Winter Garden) began shipping, and Area 1 had practically finished by the time Area 3 had its peak, yet these areas are only a few miles apart. Even more noticeable, however, Area 3 is about 100 miles northeast of Area 4 (Manatee County), yet they came on the market only two weeks apart and their peaks were during the same week. It is evident that climate was not the most determining factor, but that growers in Seminole County fit their time of planting to their crop rotation and they grow lettuce early, before celery, rather than to have the ground lie idle. On the other hand, Area 2 (Alachua and Marion Counties) marketed the bulk of its crop during the month of March as would be expected, since it is a northern area. There was but little direct competition of Area 2 with other areas in the state.

ESCAROLE

A study of escarole production, together with the time of shipments, leads one to divide the state into only two areas for escarole, with Seminole and Manatee Counties, respectively, as the chief centers. Volusia County produced 45 carloads of escarole that year. The two escarole areas were in direct competition practically throughout their entire marketing period. Like lettuce, escarole is a cool weather crop, and so its season ended about April 1. Again, the most important factor influencing the location of their crop is its competitive relation with other crops on the same land at the same time.

Nearly all of the escarole moved from the state by freight (Table 1).

EGGPLANTS

There are two areas of major importance and one minor area in the production of eggplants in Florida. They are Area 2 (Manatee), Area 3 (Ft. Myers), and Area 1 (Hernando County). This latter section, though small, is considered as a separate area due to the fact that most of its crops were produced for fall and early winter marketing not much in competition with the other areas. Area 3 came on the market December 29. It had its peak of shipments April 6, just when Area 2 started shipping in carload lots. Then during the week ending May 4, Area 2 reached a volume of five carloads by express for 25 weeks, and had its peak May 18 with 31.7 carloads. The intra-state competition, therefore, is not so noticeable with eggplants as it is with many other crops. Like the other openings revealed, there may be an opportunity in South Florida to grow a greater volume of eggplants in the fall and early winter.

The total consumption of eggplants has been comparatively small, therefore no large growing acreage has been necessary.

There were two important transportation channels for eggplants—freight and express. It is thought that express shipments ran high because first the demand is for small quantities at a time, and second price fluctuations, which cause shippers to

wish to sell quickly when price is good.

ROMAINE

In the growing and shipping of romaine there are conditions similar to those of lettuce; that is (Orange and Seminole Counties), Area 1, came on the market ahead of Area 2, yet Area 2 (Manatee County) is farther south. These two areas were on the market simultaneously during the greater part of their shipping seasons. Area 3 (Alachua and Marion Counties) did not meet excessive direct competition from the other areas, possibly because it is located farther north in the state and came on when the climate permitted. For all the areas the shipments were irregular perhaps showing not much definiteness of planting time. Nearly all (99 per cent) of the romaine left the state by freight.

FIGURE 14.—A young cucumber field in Area 1. Note the pine trees in the background. (Courtesy of Chamber of Commerce, Bradenton, Manatee County, Florida.)

GREEN CORN

There are only two important growing areas of green corn in the state. They are Area 1 (Polk County) in the south central part and Area 2 made up of five counties in the north central portion (Baker, Union, Bradford, Gilchrist, Alachua, and Marion Counties). Really the latter-named area is the one of importance when considering comparative volume, but Area 1 was on the market early, which, of course, indicated earlier planting dates. Alachua County led with a total of 132 equivalent carloads, largely from the town of Alachua. Another heavy shipping center was the town of Lawtey in Bradford County. Area 1 shipped during a period of nine weeks, and its season was practically over before Area 2 was shipping heavily. The peak for Area 2 occurred the week ending June 15, with a slightly decreased movement the following week. Of the grand total from the state of 292.5 equivalent carloads, 242 were shipped from Area 2.

SQUASHES

The four producing and shipping centers for squashes in Florida are

not difficult to segregate geographically, but the time of shipments often coincided for many counties. Squashes were marketed both in the fall and in the spring. In some counties, for example Dade County, shipments were started in November in very small amounts and continued until the end of May. On the other hand, Marion, Alachua, Levy, and other counties had both fall and spring crops. Area 1 (Alachua and Marion Counties) had less competition from other areas because of the time element. This area shipped in the early fall and also had a late spring crop. This area also had the highest peak of total shipments. On April 27 it sent 17.1 equivalent carloads, and the total shipments for the area were 66.5 equivalent carloads, mostly in a period of five weeks. Area 2 (Southeast Coast) shipped 64.8 equivalent carloads, but over a period of six months. The counties outside these areas showed a number of shipments extending from November to the middle of May.

It is very interesting to observe that despite the fact that Florida's chief truck crop production is during the winter, yet some squashes were sent from the state every week during the year studied.

OKRA

All except 12 carloads of the total of 227.2 equivalent carloads of okra was produced and shipped from three distinct areas.

The heaviest shipments of okra are made in May, June, and July, while most other crops are shipped in the fall, winter, and early spring. During the year 1928–1929 there were shipments from somewhere in the state every week except for the week ending January 12.

There was direct competition of all the areas with one another, yet the fall crop for Area 1 (Alachua, Levy, and Marion Counties) did not encounter serious competition. This was the most important area, shipping approximately 76 per cent of the okra from the state for the year. The peak came June 1, with 18.6 carloads and there were 11 weeks of comparatively heavy shipments extending from the middle of May to the middle of July.

Marion was the heaviest shipping county, followed by Alachua, Levy, and Hillsborough Counties, in order. The towns of Morriston in Levy County and Plant City in Hillsborough County were the heaviest shipping points for that year.

One hundred per cent of the okra was shipped by express. The reason is because only a total of 227.2 carloads moved from the state during the year. These shipments had a wide distribution throughout the United States and so the amounts sold were small each time, usually too small for carlots.

GREEN PEAS

There were 30 Florida counties shipping .1 carload or more of green peas to the northern markets during the year under study. None of them shipped large amounts. The most shipped by individual counties was 28.2 equivalent carloads from Palm Beach, 16.9 from Hardee, and 10.7 from Indian River.

For this commodity the state has been divided into five areas. At times during the year all of these counties were shipping simultaneously. There was a late spring crop for Area 2 (Hardee, Hillsborough, Polk, and Manatee Counties), and it did not appear to have serious com-

petition. Area 1 (Alachua-Marion) experienced three peaks during its season.

Green peas also went from the state largely by express (71.4 per cent) with 26.1 per cent by freight and a small amount by boat.

OTHER CROPS AND AREAS

There are at least 31 other truck crops of some commercial importance in Florida. Most of them are located in readily designated small areas. Like the ones discussed above, climate, soil, and other factors were largely responsible for the location.

For example, cantaloupes were grown mostly in Marion County, pineapples came from the southern counties on the East Coast because they require a warm climate. Chicory went mainly from Orange County, and parsley from Seminole. These small crops may have been located where they were as much because of individual growers seeking a paying crop for the land as anything else, especially since the large locating factors make it possible to grow them in these areas.

SUMMARY

A summary of the shipments of groups of the most important crops for the year from each county is most significant. There were 17 counties which shipped more than 1,000 carloads of the various truck crops during the year; 21 other counties shipped between 100 and 1,000 carloads, and the remaining counties shipped less than 100 carloads. Seminole County led all others in total shipments, amounting to 7,585.3 equivalent carloads, 85 per cent of which was celery. The next four crops in Seminole County, in the order of their importance, were escarole, lettuce, peppers, and cabbage. The next five highest counties were Dade, with 4,738.1 total equivalent carloads and with tomatoes amounting to 81 per cent of the total from the county. Peppers, cabbage, and green beans were the next three leading crops.

Manatee with a total of 3,537.7 equivalent carloads, with celery and tomatoes of about equal importance and representing two-thirds of the total shipments. Lettuce and cabbage and escarole were also important.

St. Johns, with a total of 3,400.7 equivalent carloads, 91 per cent of which were early white potatoes.

Alachua, with a total of 2,965.3 equivalent carloads, of which 49 per cent were watermelons, 14 per cent were cucumbers, and cabbage, beans, and early white potatoes followed in the order named.

Marion, with a total of 2,704.7 equivalent carloads, where the leading crops were watermelons 31 per cent, green beans 20 per cent, and tomatoes 18 per cent.

It is very likely that some of these counties do not remain in the same order from year to year, but that some shifting of position occurs. It is easy to understand how a heavy potato crop could enable St. John's County to displace Manatee, and Marion may sometimes ship more than Alachua. Probably there is other shifting, but on the whole this gives a picture of the most important producing counties.

There were shipments moving from the state every week in the year although only one county (Dade) actually made shipments every week as large as .1 equivalent carload. Alachua County missed shipping on the week ending December 15 and Marion County did not ship for a

period of five weeks. All other counties had vacant periods longer than five weeks.

Florida shipped more than 1,000 carloads of these commodities each week for 22 weeks from January 26 to June 22, inclusive. For 12 additional weeks the total shipments were between 100 and 1,000 equivalent carloads. Then for 18 weeks very few truck crops were shipped from the state. This slack period included the last half of July, all of August, September, and October, and the first half of November.

The heaviest week was May 4, when a total of 3,185.2 equivalent carloads of all these commodities were shipped from the state.

Since Florida plays such a large part in growing truck crops in winter for the vast northern population of the United States, it is of paramount interest that the large factors (climate, soil, water protection, comparative market costs, competition of various crops for the use of the land at the same time, location of the population of the United States, nearness to railroads, nearness to motor highways, drainage and irrigation, and topography) locating these growing areas are favorable. It is also interesting to note that there seems to be ample land for expansion in almost any crop in case there should be a greater demand sometime in the future.

BOOK REVIEWS

UNITED STATES DEPARTMENT OF COMMERCE

BUREAU OF FOREIGN AND DOMESTIC COMMERCE

Legal Aspects in Collection of Accounts in Cuba. By Mariano H. Ramirez. Trade Promotion Series No. 137. Price, 10 cents.

Cocoa in São Tomé and Príncipe. By Leonard J. Schwarz. Trade Promotion Series No. 138. Price, 5 cents.

Cocoa is the principal export crop of the São Tomé and Príncipe islands. These islands are mountainous and of volcanic origin situated in the Gulf of Guinea, about 120 miles from the mainland of French Equatorial Africa.

Commercial Travelers' Guide to the Far East. Revised Edition: 1932. Trade Promotion Series No. 134. Price, $1.00.

This volume covers Australia, British Malaya, Ceylon, China, French Indo-China, Indian Empire, Japan, Netherland India, New Zealand, Philippine Islands, and Siam. Major and secondary commercial centers are arranged alphabetically by countries and information is given on the costs and conditions of living, transportation, hotel accommodations, also climatic and sanitary conditions, business methods and customs tariffs or other municipal regulations.

Although greatly depressed, as compared with the banner years 1928 and 1929, aggregate trade between the United States and the Far East for 1931 was valued at nearly $1,000,000,000, a little over two-fifths of which consisted of exports from the United States and a little less than three-fifths of imports from the Far East. Far eastern countries continued to furnish a market for 17.4 per cent of the total United States exports, and supplied this country with 27 per cent of its total imports. We buy from the Far East 95 per cent of the raw silk we use, 97 per cent of our crude rubber imports, and 88 and 98 per cent, respectively, of our burlap and shellac needs. These Far East countries constitute by far our largest market for surplus petroleum products, raw cotton, and tobacco; and they afford an ever-increasing market for American automobiles, industrial machinery, and other manufactured goods.

Retail Credit Survey, January–June, 1932. Domestic Commerce Series No. 72. Price, 5 cents.

In view of the profound changes now going on in business, no one can forecast the credit developments of the next few years. Reliable factual information is needed as the only guide to the new and different problems which the business man will be called upon to face. Surveys are made semiannually at the request of organized groups of credit men.

Merchandising in Country Drug Stores. By John R. Bromell. Domestic Commerce Series No. 65. Price, 5 cents.

Motor Truck Freight Transportation. Domestic Commerce Series No. 66. Price, 10 cents.

Characteristics and costs of motor-truck operation by common carriers and contract haulers in intercity service.

Aids to Retail Grocery Profits. Domestic Commerce Series No. 71. Price, 10 cents.

Furniture Distribution in the West Mid-Continent. By Walter Mitchell, Jr. Domestic Commerce Series No. 68.

This west mid-continent furniture study presents furniture-distribution problems in a populous furniture manufacturing area, where a large part of all furniture moves direct from factory to retailer.

Index to Commerce Reports, for Nos. 14 to 26, Volume 2, Apr., May, June, 1932. Price, 5 cents.

Monthly Summary of Foreign Commerce of the United States, Part II, July, 1932. Price, 5 cents.

Figures for July, 1932, and for seven months ending July, 1932, corrected to September 2, 1932, subject to revision.

AERONAUTICS BRANCH

General Airway Information. Airway Bulletin No. 1, Sept. 1, 1932.

Contains maps of airways, showing beacon lights, airports, and landing fields, etc.

Descriptions of Airports and Landing Fields in the United States. Airway Bulletin No. 2, Sept. 1, 1932.

BUREAU OF MINES

Platinum and Allied Metals in 1931. Mineral Resources of the United States, 1931, Part I (pp. 89–101). By H. W. Davis. Price, 5 cents.

Silica in 1931. Mineral Resources of the United States, 1931, Part II (pp. 159–164). By E. R. Phillips. Price, 5 cents.

Gold, Silver, Copper, Lead, and Zinc in Arizona in 1930. Mine Report. Mineral Resources of the United States, 1930, Part I (pp. 1085–1142). By C. N. Gerry and T. H. Miller. Price, 5 cents.

BUREAU OF THE CENSUS

Retail Distribution, State Series, Census of Distribution: Arizona, California, Delaware, Illinois, Louisiana, Minnesota, Missouri, Nebraska, North Carolina, North Dakota, Oregon, Pennsylvania, South Dakota, and Tennessee.

Retail Distribution, Merchandising Series, *Automobile Accessory Chains*, including Tire Chains and Battery Chains.

Retail Distribution, Merchandising Series, *Motor Vehicle Dealer Chains*, including Used-Car and Aircraft Dealer Chains.

Retail Distribution, Merchandising Series, *Newsdealer Chains*, including Newsdealer-Restaurant Chains, Book-Store Chains, Stationery Chains, Art and Gift Shop Chains, Novelty-Store Chains.

Wholesale Distribution, State Series, Census of Distribution: Indiana, Kansas, Kentucky.

Construction Industry, State Series; Arizona.

MILDRED R. BASHORE

First Report on Foreign Geographic Names. U. S. Geographic Board. U. S. Government Printing Office, Washington, 1932.

The United States Geographic Board has published a report of more than 100 pages devoted exclusively to foreign geographic names. The "First Report on Foreign Geographic Names" gives the proper spellings of nearly 2,500 of the more important names of countries, cities, provinces, rivers, and other natural features in all parts of the world.

All previous decisions of the Geographic Board with reference to foreign geographic names are superseded by the new report. It contains more than twice as many decisions as have heretofore been published concerning foreign geographic names. Many of the previously published decisions were rendered before the World War, and had not been revised to agree with subsequent changes. In the present report many of these have been revised—some in the spelling of the name, and others only in the definition and description of the term. Former decisions of temporary significance have been vacated and omitted from the report.

By requirement of Executive orders, the spellings given in the new report will be followed by all departments and establishments of the Federal Government. In preparing the report, the point of view not only of the Government but also of many publishers and business firms has been considered, and the committee has carried on a wide correspondence in formulating the policy which the Board has adopted. The Board is assured that its decisions will be followed by many publishers and commercial firms in the United States.

Among the decisions relating to names not uniformly spelled in current publications may be cited Tokyo, it being indicated that this is the official Japanese romanization (not Tokio), while in the body of the report it is stated that such names are pronounced as two instead of three syllables. Yugoslavia is given as the correct spelling of the name of the country, the form Jugoslavia being Italian. Other important names are Estonia (not Esthonia), Monterrey (not Monterey), and Capetown (not Cape Town).

Interesting and perplexing problems involved in spelling foreign geographic names are discussed from a common-sense point of view, in 30 pages of test. Practical as well as theoretical problems are considered. For example, the suggestion is made that, in order to insure prompt delivery of mail addressed to foreign countries a letter "is more certain to be delivered properly and promptly if the address is written in the language of the country to which it is going. The name of the country, however, may better be given in the English form, as it facilitates handling on the part of postal employees in the United States up to the time when it is loaded on to the proper steamer. A letter addressed to Livorno, Italy, may be more promptly delivered than one addressed to Leghorn, just as a letter addressed in Italy to Salt Lake City, Utah, is likely to be delivered more speedily than one addressed to Citta del Lago Salato."

In the discussion of theoretical and linguistic problems the difficulties which are found in spelling foreign geographic names are stated to arise largely from the fact that the alphabets in which many foreign languages are written are based upon the ancient Latin or Roman alphabet, whereas nearly all of such languages have sounds which are foreign to ancient Latin.

The report gives both the "local official" and the "conventional English" forms of names for the same place (where separate forms exist), for example 's Gravenhage and The Hague, Firenze and Florence, Warszawa and Warsaw. Such names are all given in boldface type. Because foreign addresses are often written in other languages, as a practical help to the users of the report the forms of the names in the languages of adjacent countries, and in French and German, are frequently given. All such names, together with incorrect spellings most commonly found in English publications, are alphabetically cross-referenced to the "local official name" entry, which indicates the country in which it is found and gives the latitude and longitude and other pertinent information.

Much useful information is packed into some of the decisions. Thus the city in Brazil which is frequently referred to in English as Pernambuco is properly Recife, the former name being that of the state of which the city is the principal seaport. Similarly Quintana Roo, formerly a territory of Mexico, was divided on December 18, 1931, between the states of Campeche and Yuca-

tan. Under Schlesien (Silesia) there are given the names of the countries to which portions of German Silesia and Austrian Silesia were lost, and the equivalent names in the languages of the new countries. Such confusing names as Slavonia, Slovenia, and Slovakia are differentiated. The pronunciation of many names is given.

The report contains a general transliteration table, which is the basis of all spellings of names in countries which do not use a Latin alphabet, due in part to the lack of a generally accepted transliteration scheme and to the recent simplification of the Russian alphabet, the report contains the special table for the transliteration of Russian which has been followed in the preparation of the report. The table is such that it may be conveniently used in transliterating Russian names which are not included in the present report.

The majority of questions referred to the Geographic Board, by government departments and by publishing houses and others, relate to geographic names in the United States and its possessions. The demand for decisions relating to foreign commerce and of interest in international affairs, until it was necessary for the Board to give special consideration to foreign names. It is believed that the names selected for inclusion in the report just published will answer the great majority of questions which arise. As a practical means of economy of money and time, the Board has prepared a rule of procedure to be followed by government departments in the absence of a published decision on a specific name. The Board has listed foreign publications which are to be used in such cases, and has made arrangements for their sale in the United States.

The United States Geographic Board was created, and its responsibilities were prescribed, in an executive order issued by President Harrison, in 1890. Originally called the "Board of Geographic Names," its official title was changed to "United States Geographic Board" by President Roosevelt in 1906, in an executive order which stipulated that "in all cases of disputed (geographic) nomenclature, the decisions of the Board are to be accepted by the departments of Government as the standard authority."

The chairman of the Board is Mr. Frank Bond, and the secretary is Mr. John J. Cameron. The committee on foreign geographic names, which prepared the report now published, consists of Mr. S. W. Boggs, geographer of the Department of State, and Dr. Helen M. Strong, geographer of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Press Release

DIESEL, EUGEN. *Das Land der Deutschen.* 259 pp. (9¼ by 11½ in.), 48 illustrations, 2 maps, index. Bibliographisches Institut A. G., Leipzig, 1931.

About a year ago the Bibliographisches Institut of Leipzig, well known for their outstanding achievements in the publishing field, added another title to the long list of their publications of great interest to the geographer. "Das Land Der Deutschen" in many respects is a new departure from the regular line of geographical books. Fully four-fifths of the space of the 259 large pages is occupied by illustrations, most of them aeroplane photographs, giving literally a bird's-eye view of the country. Most of these aeroplane pictures are the work of Robert Petschow, a pathfinder in this modern venture of pictorial education.

While representing only a minor feature of the work, when appraised with regard to space covered, the text, because of its high quality, adds materially to the value of the book. This quality is not only a matter of excellent literary style but also of stimulating and thought-provoking content. The text is written by Eugen Diesel, who in recent years has attracted considerable attention by his appraisal of the impact of machine technique on culture and civilization.

The ideas of Diesel control the arrangement of the subject matter. The book is divided into three main parts: natural landscape, cultural landscape, and machine age. While, as Diesel points out, only a small portion of the German landscape has preserved its primeval nature, nevertheless 141 of the 481 illustrations are devoted to its pictorialization. The discussion of the natural landscape is divided into four sections dealing with major topographical figures: coastlines, north German plains, central mountain ranges and the Alps; water as a feature of the landscape including rivers and lakes; climate and seasons; and original flora and fauna. Climate is treated primarily through clouds, ice formation, and other indirect manifestations of primary climatic forces. Each picture is discussed and its organic relationship to the whole is carefully worked out. In the section dealing with topographical features geological aspects are treated briefly but scientifically. The pictures showing rock formations are exceedingly interesting.

The second part dealing with the cultural landscape is illustrated with 150 pictures showing the present status of agriculture, forestry, mining, fishing, shipping, roads, habitation, villages, towns, early cities and ways and means of providing amusement and diversification under the ancient culture pattern resting primarily on agriculture and on the use of muscular energy of man and beast. We fly over teams of oxen plowing in the spring, over rye fields whose water veins are strangely visible from the height of the aeroplane. We see the damage done by hail, we watch harvesting in progress, we fly over villages, forests, quarries, mines. In short, we get a clear picture of that part of German life which has not yet definitely come under the domination of the machine. Only a few pictures are devoted to the old machines, especially windmills and water wheels. On the whole the machine is decidedly a minor aspect of this ancient culture pattern. Most of

the work is done by human labor and supported by work and draft animals. We see young men and boys stripped to the waist digging peat in one of the bogs; we see fishermen supported by no mechanical device hauling in their nets. A sailing ship passes by propelled by no other force than the wind. All land transportation depends on animals.

The cities shown in this part are all products of pre-machine civilization. The need of security from attack by robbers or enemies of the state seems to have been one of the major factors affecting or determining the layout of human habitation. Also the outstanding position of the feudal lords is clearly visible in the large portion of land allotted to the princely parks, stately castles and the imposing public buildings through which these rulers sought to express their cultural and dynastic ambitions.

The fact that the man-made landscape is split into two distinct parts—the cultural landscape and the machine environment—is of particular interest. In the introduction Diesel stresses the functional difference between the cultural landscape as it developed before the Mechanical Revolution and the environmental changes which have gone on since then. While the former are organically related to the natural background and seem to reflect a more or less passive adaptation to the natural features of the earth, the machine environment in general appears as an artificial veneer and, in its extreme manifestations, seems to fight against nature rather than to reflect passive adaptation. The old villages formed out of the stuff found on the surface of the landscape seem to blend into their natural background. The modern city, built from mineral raw materials brought up from the depths of the earth and hauled hundreds or even thousands of miles, appears as an artificial superstructure loosely attached to the face of the earth.

The third part deals with the artificial changes which machine civilization has wrought. We fly over smoke stacks belching forth their black clouds, over ports, terminals, and railroad yards, over gas tanks, and canalized rivers, over oceans of stone marking the modern metropolis, etc. At times our aeroplane dips down and gives us a close view of some of the outstanding achievements of modern city architecture in Germany. Thus, we see the famous Chile House of Hamburg, the well-known Marx Building of Düsseldorf, etc. Two maps showing physical features and geological formations respectively bring up the rear.

There are few books which have given the reviewer as much pleasure and at the same time afforded so much stimulating thought and imparted so much valuable information as this book on "The Land of the Germans." Not only the geographer but educated and cultured persons in general will take delight in this excellent publication. Not only those particularly interested in Germany but all those who wish to gain a clear picture of the gentle transformation of the landscape by ancient culture and of the violent impact of the machine on nature will study this volume, its text, and its almost 500 pictures to great advantage.

ERICH W. ZIMMERMANN

SCHUTZMEISTER, PHILIPP. *Der Mensch auf den Atollen der Südsee.* Hamburg, 1932.

HEIN, CHRISTIANE. *Madagaskar.* Hamburg, 1932.

Both dissertations of the University of Hamburg show, as could be expected, the strong influence of Professor Doctor S. Passarge, director of the geography department. The study of South Pacific atolls, based only on literature and lacking sadly personal observation as a result, is a studious compilation of what is published in the German language on this subject. The life of the natives in its dependence upon the very limited geographical environment is brought out clearly, and in that way the book serves its purposes.

The study of Madagascar suffers from the same disadvantage, this is, lack of personal knowledge; but using a complete literature, especially of recent French authors, a regional division is given based on Passarge's systematic principles. The following regions are recognized:

1. East Madagascar, a crystalline escarpment complex with dense rain forest.
2. The Alaotra-Mangoro region, a rift valley with steppe-like vegetation, surrounded by densely forested mountains.
3. The Central Highlands, a broken crystalline tableland, with gallery forests and grasslands.
4. West Madagascar, a limestone-sandstone escarpment landscape with savanna vegetation.
5. The Sambirano region, another steppe, is surrounded by forested ranges.
6. North Madagascar, a crystalline volcanic and limestone mountain section with steppe vegetation.
7. The dry south, a dry plateau.

Each region is subdivided. A geographical description is given with special stress on the life of the inhabitants. The accompanying maps are interesting, but small. A map of land utilization is missing and a larger detailed map for orientation would have been valuable. The scientifically exact terminology of Passarge makes rather tiresome reading.

SAMUEL VAN VALKENBURG

ANNOUNCEMENT

THE series on the *Agricultural Regions of the World* is continued in this issue with an instalment of *Agricultural Regions of Asia* by Dr. Samuel Van Valkenburg. The series on Agricultural Regions of North America by Dr. O. E. Baker will be continued in the next issue. This will be followed in a later issue by *Agricultural Regions of Africa* by Homer L. Shantz, President of the University of Arizona, and will complete the finest geographic discussion of the world's agriculture thus far published.

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Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
Nomadic Pastoral Regions, Wellington D. Jones, University of Chicago, and Derwent S. Whittlesey, Harvard University.
Pattern of Copper Mining Terrene Occupancy in the South Range, Keweenaw Peninsula, Robert S. Platt, University of Chicago.
Economic Aspects of the Danubian Plan, Joseph S. Roucek, Centenary Junior College, Hackettstown, N. J.
The North Kansas City Urban District, John Q. Adams, University of Missouri.

July includes:

The Ports of Finland, Karl Kekoni, High School, Ekenäs, Finland.
Agriculture of the Southern High Plains, J. Sullivan Gibson, Western Kentucky State Teachers College.
The Banana in Caribbean Trade, Jesse T. Palmer, University of Illinois.
Iron and Steel Industry of Wheeling, West Virginia, Langdon White, Western Reserve University.
Competing Cottons and United States Production, William G. Reed, George H. McFadden & Bro., Philadelphia, Pennsylvania.
Economic Adjustments on the Olympic Peninsula, Albert L. Seeman, University of Washington.
Wild Plant Industry of the Southern Appalachians, Ina C. Yoakley, State Teachers College, Johnson City, Tennessee.

April includes:

Agricultural Regions of Asia, Samuel Van Valkenburg, College of the City of Detroit.
Manchuria: The Land and Its Economy, John R. Stewart, National Credit Office, New York.
Export Wheat Producing Regions, Helen M. Strong, Bureau of Foreign and Domestic Commerce.
Importance of Pipe Line Transportation, John K. Rose, Clark University.
Classification of North American Climates: A Review, Stephen B. Jones, Harvard University.

January includes:

Land Utilization in the Lower Rio Grande Valley of Texas, Edwin J. Foscue, Southern Methodist University.
Agricultural Vermont, S. Axel Anderson, Columbia University, and Florence Woodard, University of Vermont.
The Population of the Netherlands, J. F. Bogardus, University of Pennsylvania.
Coffee Industry of Central America, Louise Hearst, Iowa State Teachers College.
Edwards Plateau, A Combination Ranching Region, William T. Chambers, Stephen F. Austin State Teachers College.
Buffalo as a Flour Milling Center, Laura O'Day, Buffalo Museum of Science.
Dry Farming in the San Joaquin, California, Samuel N. Dicken, University of Minnesota.

The October issue of Volume 7 contains the following articles:

Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
Sheep Rearing in New Zealand, R. Ogilvie Buchanan, University of London, University College.
The Significance of Drain Tile in Indiana, W. LeRoy Perkins, University of Chicago.
Economic Geography of Roumania, Joseph S. Roucek, Centenary Junior College, Hackettstown, N. J.
Fiji Sugar Industry, C. J. Robertson, International Institute of Agriculture, Rome, Italy.
Trans-Montana Routes of Colorado, Ralph H. Brown, University of Minnesota.

July includes:

Agricultural Regions of Asia, Samuel Van Valkenburg, College of the City of Detroit.
The Geography of Chosen, J. Wright Baylor, University of Cincinnati.
The Mississippi River—Asset or Liability, William H. Haas, Northwestern University.
Sheep Industry of Southeastern Ohio, Langdon White, Western Reserve University, and Clyde E. Cooper, Ohio University.
Chilean Nitrate and the Nitrate Revolution, R. H. Whitbeck, University of Wisconsin.
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